The British Army and the politics of rifle development, 1880 to 1986

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The British Army and the Politics of Rifle Development, 1880 to 1986

by

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Abstract

This thesis is concerned with the design and development of British infantry rifles. The specific weapons considered are the Lee-Metford (LEME) first introduced in 1888; the Short Magazine Lee-Enfield (SMLE) brought into service in 1904; the Experimental Model No.2 (EM2) briefly designated the Rifle No.9 Mk.1 in 1951; and the Section Small Arms Post 1980 (SA80) issued to troops in 1986.

Over the past twenty years academic literature has demonstrated that technological determinism has persistently crept into accounts of technical change. By consistently leaving human agency out of the equation, technology has appeared to evolve autonomously and to have determinate effects. Whilst studies of civilian technologies have shown that this way of seeing has serious flaws, very little has been undertaken to show how the same issues arise in a military context. The approach adopted here explicitly aims to highlight and avoid problems of technological determinism by putting human choice back into the story of British rifle design.

This is achieved through the identification of key personalities and social groups who had a perspective on, and an interest in, the development of the various systems. Having identified the key actors, their views on each artefact are explored. What emerges is that different groups see a particular technical solution differently. The arguments about what must be included in, and what is irrelevant to, a design of rifle are as a result exposed for further examination. The eventual weapon that emerges from these debates can be seen as a negotiation among the various parties: an artefact around which various perspectives coalesce. What transpires is a detailed picture of the tactical problems each weapon attempts to resolve. This not only indicates how various groups see the battlefield problem but also describes how these same actors want the infantry to fight.

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List of Abbreviations

ABC	America Britain Canada
A/CEAD	Assistant Chief Engineer Armament Design
ADE	Armament Design Establishment
AFV	Armoured Fighting Vehicle
ARWEN	Anti-Riot Weapon Enfield
BAR	Browning Automatic Rifle
BAOR	British Army of the Rhine
BBC	Britain Belgium Canada
BEF	British Expeditionary Force
BJSM	British Joint Services Mission
CEAD	Chief Engineer Armament Design
CGS	Chief of the General Staff
CIGS	Chief of the Imperial General Staff
CSA	Chief Scientific Advisor
CS(M)	Controller Supplies (Munitions)
DCIGS	Deputy Chief of the Imperial General Staff
DGofA	Director General of Artillery
DGMT	Director General of Military Training
DGO	Director General of Ordnance
DInf	Director of Infantry
DMT	Director of Military Training
DNO	Director of Naval Ordnance
DofA (SA)	Director of Artillery (Small Arms)
DSD	Director of Staff Duties
DWD	Director of Weapons and Development
EM1	Experimental Model No.1
EM2	Experimental Model No.2
EPOR	Empirical Programme of Relativism
FAL	*Fusil Automatique Léger*
FARELF	Far East Land Forces

FN	*Fabrique Nationale d'Armes de Guerre*
GPMG	General Purpose Machine Gun
GSR	General Staff Requirement
IPW	Infantry Personal Weapon
IRA	Irish Republican Army
IW	Infantry Weapon
LEME	Lee-Metford
LMG	Light Machine Gun
LSW	Light Support Weapon
MICV	Mechanised Infantry Combat Vehicle
MG	Machine Gun
MGO	Master General of Ordnance
MMG	Medium Machine Gun
MOD	Ministry of Defence
NATO	North Atlantic Treaty Organisation
NRA	National Rifle Association
OB	Ordnance Board
OWPC	Organisation and Weapons Policy Committee
RSAF	Royal Small Arms Factory
SA80	Section Small Arms Post 1980
SAA	Small Arms Ammunition
SAG	Small Arms Group
SCOT	Social Construction of Technology
SSK	Sociology of Scientific Knowledge
SLEM	Self-Loading Experimental Model
SLR	Self-Loading Rifle
SMG	Sub-Machine Gun
SMLE	Short Magazine Lee-Enfield
SST	Social Shaping of Technology
STANAG	NATO standardisation agreements
SUSAT	Sight Unit Small Arms Trilux

VCGS	Vice Chief of the General Staff
VCIGS	Vice Chief of the Imperial General Staff
WTS	Weapons Technical Staff

Glossary of Terms

Aperture sights	A rifle's rear sight consisting of a small circular aperture through which aim is taken.
Beaten zone	A beaten zone is the area of fallen shot between the first catch and the last graze of a bullet's trajectory.
Breech loading	Loading the weapon by inserting ammunition through an opening at the rear (or breech) end of the weapon's barrel.
Bolt:	A cylindrical sliding bar for closing the breech of a weapon. Typically the bolt is hollow so that when the rifle is cocked a striker (sometimes also known as a firing pin) contained within the mechanism is held under tension by a mainspring away from the firing chamber. Upon pressing the trigger, the tension on the mainspring is released allowing the striker to move towards the firing chamber where it strikes the rear of the ammunition.
Bore:	The internal diameter of the barrel. See also calibre.
Bullpup rifle:	A weapon which has been shortened by the removal of the butt and the repositioning of the trigger house mechanism forward of the magazine. Typically, the barrel of a bullpup design is comparable to that of a conventionally configured rifle.
Calibre:	The nominal internal diameter of the bore of the barrel.
Charger:	A holder for containing several cartridges. On loading, the cartridges are swept out of the charger into the magazine, the charger falling away.
Clip:	A holder which contains a number of cartridges for the magazine of a rifle. On loading, the clip and cartridges are inserted into the magazine and the clip drops out of the bottom when the magazine is empty.
Dial sights:	A sight attached half way down the length of the wooden hand guard. By elevating the rifle the shooter could look through an aperture sight to the side of the receiver to the dial site and as a result zero in on targets out to the 3000 yards.

Fouling: The residue of any unspent propellant left in the barrel of the weapon. The build up of fouling eventually leads to the weapon jamming.

Iron sights: Conventional sights not benefiting from any optical or image enhancing equipment.

Muzzle loading: Loading the weapon by ramming a projectile down through the end of the barrel.

Muzzle velocity: The velocity of the projectile at the muzzle of the gun.

Optical sight A sight that provides optical magnification, sometimes also known as a telescopic sight

Rifling: Spiral grooving inside the barrel of the weapon used to make the projectile spin around its axis. This has the effect of making the projectile more stable in flight. Rifling is usually measured in terms of one turn in a certain distance e.g. 1 turn in 22 inches (a 1 in 22 turn).

Rounds per minute: The number of firing cycles undertaken by an automated fire and feed weapon.

Chapter One - Introduction

The design of British magazine infantry rifles 1880 - 1986

This thesis is concerned with the design and development of British infantry rifles. The specific weapons considered are the Lee-Metford (LEME) first introduced in 1888; the Short Magazine Lee-Enfield (SMLE) brought into service in 1904; the Experimental Model No.2 (EM2) briefly designated the Rifle No.9 Mk.I in 1951; and the Section Small Arms Post 1980 (SA80) issued to troops in 1986. The Self-Loading Rifle (SLR) which was introduced in 1957 was developed in parallel with the EM2 and selected only after Winston Churchill insisted on an American calibre of ammunition. Because of this the SLR is not examined directly but only in reference to the EM2 and the weapon that replaced it: the SA80. This choice of firearms reflects the transition by the British Army to a bolt-action, magazine-fed rifle and then to a self-loading and ultimately a fully selective fire weapon.

This thesis aims to explain why British infantry rifles have been designed in the way that they have: why they take the form that they do. Over the past twenty years academic literature has demonstrated that technological determinism has persistently crept into accounts of technical change. By consistently leaving human agency out of the equation, technology has appeared to evolve autonomously and to have determinate effects. Whilst studies of civilian technologies have shown that this way of seeing has serious flaws, relatively little has been undertaken to show how the same issues arise in a military context. The approach adopted here explicitly aims to highlight and avoid problems of technological determinism by putting human choice back into the story of British rifle design.

This is achieved through the identification of key personalities and social groups who had a perspective on, and an interest in, the development of the various systems. Having identified the key actors, their views on each artefact are explored. What emerges is that different groups see a particular technical solution differently. The arguments about what must be included in, and what is irrelevant to, a design of rifle are as a result exposed for further examination. The eventual weapon that emerges from these debates can be seen as a negotiation among the various parties: an artefact around which various perspectives coalesce. What transpires is a detailed picture of the tactical problems each weapon attempts to resolve. This not only indicates how various groups see the battlefield problem but also describes how these same actors want the infantry to fight.

Why study rifles?

Scholarly interest in the design and development of British magazine rifles has been notably lacking.[1] That is not to suggest that these weapons have not attracted comment but it would be fair to say that no effort has been made to understand why they have taken the specific form that they have. Where firearms have caught the academic eye is either in relation to their impact on the battlefield or where the technology fits into the broader sweep of military-technical change. In the case of the former, the appeal generally peaks with the supposed firepower revolution of the late 19th century.[2] In the case of the latter, small arms have invariably performed the literary function of stepping stone in a general argument that traces the evolution of hardware and tactical technique

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[1] There are, however, two PhD theses on the related issue of British armoury practice. One is focused on management techniques in the Government Manufactories, the other concerned with mass production, interchangeability and design. See J. H. Lewis, The Development of the Royal Small Arms Factory (Enfield Lock) and its Influence upon Mass Production and Product Design c1820-1880, (PhD, Middlesex University, London, 1996); J. Black, The Development of Professional Management in the Public Sector of the United Kingdom from 1855 to 1925: the Case Study of the Ordnance Factories, (PhD, Open University, 2000). In addition there is one MSc thesis concerned with technical change and small arms manufacture. See C. Duff, British Armoury Practice: Technical Change and Small Arms Manufacture, 1850 - 1939, (MSc, University of Manchester, Manchester, 1990). Neither the MSc nor the PhD theses explore how specific British Army requirements were reflected in weapon design. By way of a contrast with the lack of interest in British firearms, two American academics have written fascinating studies on the development of the M-16. See E. Ezell, 'Cracks in the Post-War Anglo-American Alliance: The Great Rifle Controversy, 1947-1957', Military Affairs, Vol: 38, No: 4 (1974); T. McNaugher, 'Marksmanship, McNamara and the M16 Rifle: Innovation in Military Organizations', Public Policy, Vol: 28, No: 1 (1980); E. Ezell, The Great Rifle Controversy: Search for the Ultimate Infantry Weapon from World War 2 through Vietnam and Beyond, (Harrisburg, Pa.: Harrisburg 1984); T. McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, (New York: Praeger, 1984).

[2] See for example: Edward M. Spiers, 'The Use of the Dum Dum Bullet in Colonial Warfare', Journal of Imperial and Commonwealth History, Vol: 4, (1975); Edward M. Spiers, 'Reforming the Infantry of the Line, 1900-1914', Journal of the Society for Army Historical Research, Vol: 59, (1981); E. M. Spiers, The Late Victorian Army, 1868-1902, (Manchester: Manchester University Press, 1992). David French has also shown an interest in British small arms but specifically in relation to questions of infantry firepower, see D. French, Raising Churchill's Army: the British Army and the War Against Germany, 1919-1945, (Oxford: Oxford University Press, 2000).

from longbow to nuclear bomb.[3] In both cases, after briefly considering the role of rifles attention wanders to ostensibly even more decisive war-winning technologies such as the machine gun, the tank, or the aircraft. As a consequence the rifle's importance is seemingly limited to a brief period of battlefield dominance soon superseded by other more important technical wonders.

With academics showing no direct interest in the design of British rifles, the field has been left open to the enthusiast who, in their eagerness to describe the engineering problems involved, have unwittingly introduced technological determinism into their accounts of this technology.[4] This is unfortunate because the picture that they encourage is one where the development of small arms appears to evolve according to some inevitable course of events. The central theme running through this reading of military-technical change is that each firearm is somehow an improvement on its predecessor: single-shot weapons are replaced by self-loading equivalents that increase the quantity of fire that could be generated. In turn these are upgraded to selective fire rifles that can maintain continuous fire if necessary. With each iteration the suggestion is that designers are ironing out engineering problems, increasing killing efficiency and thereby closing the gap between the 'ideal' form of infantry weapon and its reality. The underlying assumption upon which such a view depends is one where the tactical considerations facing an army remain the same over time.

Unfortunately for the enthusiasts, however, a careful consideration of the evidence demonstrates that this way of seeing cannot be sustained. Secondary sources indicate that the War Office was looking at the possibility of a personal automatic firearm from the

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[3] See for example: B. Brodie, From Crossbow to H-Bomb, (Bloomington, IN: Indiana University Press, 1962); T. N. Dupuy, The Evolution of Weapons and Warfare, 2nd, (New York, N.Y: Da Capo Press, 1990); J. F. C. Fuller, Armament and History, (New York: Charles Scribner's Sons, 1945); Michael Howard, War in European History, (Oxford: Oxford University Press, 2001); W. H. McNeill, The Pursuit of Power: Technology, Armed Force and Society since A.D. 1000, (Chicago: University of Chicago Press, 1982); H. Strachan, European Armies and the Conduct of War, (London: Allen & Unwin, 1983); M. Van Creveld, Technology and War: From 2000 B.C. To the Present, 2nd edn., (London: Brassey's, 1991).
[4] This will be explored more fully in the following literature review.

time of the Russo-Japanese War.[5] Yet, despite, this the British Army only adopted such a weapon in 1957, twenty years after the first country in the world had done so.[6] If the development of small arms followed a predetermined course then Britain's armed forces would have introduced a selective fire rifle earlier than in 1986, more than forty years after the German *Wehrmacht* had been issued an equivalent during the Second World War. That it did not suggests that there is a problem with the enthusiasts' account of military-technical change.

This discrepancy between technical possibility and the time it took Britain's Army to make use of state-of-the-art firearms points to a series of questions that are the central concern of this thesis. The first cluster of issues is related to the notion that firearms evolve along a fixed path. Is it the case that British rifles evolved towards some kind of ideal form? What does such an idea suggest about the role of human choices in weapons design? Is this not just another form of technological determinism and if so can its underpinning logic be defended? The second line of enquiry stems from this and is concerned with gauging the way organisations adapt and respond to technical possibilities: the extent to which they shape and are shaped by technological systems.

That the British Army has been attempting to find particular solutions to specific tactical problems as it has identified and understood them is a matter for further empirical research. This thesis intends to fill this evidential gap by showing that the solutions that have been developed have been a response to battlefield concerns, not a result of seeking an ideal form of military hardware. In the process this study will also show how answers to a wider series of questions can also be articulated. These questions are not only related to how the Army sees the battlefield but additionally involve clarifying the complexities of technical change and how it is orchestrated within the military organisation. What will

[5] T. Travers, The Killing Ground: The British Army, The Western Front and the Emergence of Modern War 1900-1918, (Barnsley: Pen and Sword Military Classics, 2003), pp. 65-66. It should be noted that a more detailed survey of the evidence shows that the Director General of Ordnance started a programme to investigate automatic rifles in 1901, see memo titled 'Automatic Rifles', in 'Provision of Automatic Rifle: List submitted to War Office and considered by Small Arms Committee, 1902-1904', WO 32/9082, National Archive.
[6] The United States Army was the first to select a self-loading rifle in 1937. This weapon was known as the M-1 Garand.

become clear is that, at least in relation to the British Army, the view that tactical problems are unchanging is laced with many suppositions that require careful consideration if the pitfall of technological determinism is to be side stepped.

Technological determinism

Before it is possible to show why it is best avoided and how the rifle enthusiasts unwittingly reproduce it, it is first necessary to explain what technological determinism consists of. There are two central tenets to a theory of technological determinism. The first is that technical progress conforms to its own logic: it is neither culturally nor socially determined but follows a course along a fixed causal path towards ever more advanced configurations.[7] Consequently artefacts evolve from lower to higher levels of development in what some might describe as a technological trajectory.[8] The second is that because of the chain of causality involved, society is compelled to modify itself so as to incorporate these changes.[9] Thus, according to a technological determinist the invention of a tank, for example, forces armies to adopt and then by necessity adapt to them. Once in the military inventory, tanks continuously improve and armies have to procure ever more advanced designs.

This view of the determinist position depends on a particular definition of technology that, to avoid tautological argument in what follows, it makes some sense to describe. There are several ways the term could be understood, the most restrictive of which is that of a physical object. However, technology can also be taken to include the knowledge and processes necessary for creating an artefact as well as the methods and systems by which its creation is organised and controlled.[10] Clearly, if these additional elements are included then technical change would be the result of human choice. As technological determinism is premised on its absence, to include human agency in a characterisation of

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[7] B. Bimber, 'Three Faces of Technological Determinism', in Does Technology Drive History? The Dilemma of Technological Determinism, L. Marx and M. Roe Smith (eds.), (Cambridge Mass.: MIT Press, 1994), p. 84.
[8] D. A. MacKenzie and J. Wajcman (eds.), The Social Shaping of Technology: How the Refrigerator Got its Hum, 2nd edition, (Milton Keynes: Open University Press, 1999) p. 10
[9] Bimber, 'Three Faces of Technological Determinism' p. 84.
[10] Ibid., pp. 87-88.

technology would mean allowing social factors into such descriptions via the back door. By carefully navigating round this possibility, the internal coherence of the determinist position is retained.

One of the benefits of defining technology as just the physical object is that it helps stake out the logical extremities of the technological determinist argument thereby making it easier to expose the theory's inherent weaknesses. Indeed, a critical assessment of the underpinning logic reveals that the arguments at their most theoretical level cannot be sustained when examined closely. To be determined means that certain laws or rules apply to link technical cause with technical or societal effect. Thus uncovering the laws establishes a means for calculating how future events will unfold.[11] A theory of technological determinism does therefore have to be capable of prediction: accounting for technical and societal events that have yet to occur. Clearly this is a very high hurdle across which the technological determinist has to jump and it can come as no surprise that at this point, the theory cannot be defended.

But problems with determinism do not just occur at a theoretical level: they can be demonstrated empirically as well. A number of studies undertaken in the field known as the Social Shaping of Technology (SST) have demonstrated that notions of technological determinism do not coincide with the data relating to the way technology evolves in practice.[12] Whilst SST has mainly investigated the nature of technical change in a civilian context, there is one significant piece of work that has demonstrated the applicability of this way of seeing in a military setting. Donald MacKenzie's book *Inventing Accuracy: a Historical Sociology of Nuclear Missile Guidance* has shown that far from being an inevitable consequence of autonomous technological improvements the

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[11] Ibid., pp. 86-87.

[12] For good examples of SST literature in relation to civilian technology see W. E. Bijker, T. Hughes and T. J. Pinch (eds.), The Social Construction of Technological systems: New Directions in the Sociology and History of Technology, (Cambridge, Mass.: MIT Press, 1989); W. E. Bijker and J. Law (eds.), Shaping Technology/Building Society: Studies in Sociotechnical Change, (Cambridge, Mass.: MIT Press, 1992); W. E. Bijker, Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change, (Cambridge, Mass.; London: MIT Press, 1995); K. Grint and S. Woolgar, The Machine at Work: Technology, Work, and Organization, (Cambridge: Polity Press, 1997); N. Oudshoorn and T. J. Pinch (eds.), How Users Matter: the Co-construction of Users and Technologies, (Cambridge, Mass.; London: MIT Press, 2003).

very meaning of accuracy had to be socially constructed;[13] the corollary being that there was no inevitable path along which the evolution of missile guidance followed. As MacKenzie shows, different technical options were open to those parties interested in accuracy and this did not necessarily mean that the latest guidance design superseded previous versions. Indeed, as *Inventing Accuracy* demonstrates the current generation of missile does not use the latest generation of laser guidance system because it is not considered to be as accurate as older configurations.[14]

Any approach to military-technical change that seems to imply technological determinism ought, therefore, be scrutinised with some care. Whilst there are all sorts of reasons why it can be easier to think of technology in terms of cause and effect, this shorthand way of seeing technical change cannot do justice to either the empirical evidence or the theoretical framework which helps make sense of the data. Thus, by stretching the technological determinist position to its limits the foundation for this thesis becomes easier to articulate. Notions of technical change that leave out human agency lack plausibility and ought not to form the basis for further investigations into British magazine rifles.

Literature review

Most scholars interested in technology know to look out for and steer clear of determinist overtones in their descriptions of technical change.[15] However, as this next section shows the same does not apply to what David Edgerton has described as the 'non-knowledge of technology' epitomised in the literature on firearms.[16] This is because, whilst the academic community finds small arms only transitorily interesting, the specialist weapon enthusiast tends towards overly detailed description that centres on the technical and mechanical aspects of rifle design. No doubt of interest to the engineer, this kind of narrative fails to relate the weapon to its wider social context whilst claiming that rifles are the way they are purely for technical reasons. The implication is that a rifle

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[13] D. MacKenzie, Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance, (Cambridge, Mass.: The MIT Press, 1990).
[14] Ibid., p. 238.
[15] D. Edgerton, 'Tilting at Tigers', British Journal for the History of Science, Vol: 26, (1993), pp. 70-71.
[16] Ibid., p.74.

evolves autonomously without significant human intervention. This clearly has technologically determinist connotations.

There are only eight books that deal directly with the LEME, SMLE, EM2, and SA80: one that covers both the LEME and the SMLE, four on the SMLE, two on the EM2 and one on the SA80. These books have not been written by academics and this goes some way to explain why their narratives lack a theoretical framework for understanding the way in which technological choices are situated within a wider context. The authors are primarily interested in the technical item itself and write chronological narratives about the mechanical changes made to their particular firearm. Consequently they explain how design decisions were taken as if they were only related to complex problem solving exercises. As a result the authors assume that each rifle took the form that it did primarily because of engineering rather than human imperatives.

The most widely recognised author on the Lee-Enfield family of weapons is Ian Skennerton. Skennerton, who served with the Australian Army in Vietnam, assumes the reader has some prior knowledge of firearms. He has written several pieces on the Lee-Enfield, has a comprehensive website aimed at the collector of these weapons, publishes his own material and has recently started to produce pamphlets called *Small Arms Identification Series* on the Lee-Enfield series of rifles.[17] Whilst these pamphlets are directly aimed at the collector, the main citable work that Skennerton has produced is called *Lee-Enfield Story*.[18] In this book an account is provided of the whole Lee-Enfield family of weapons from the LEME to the Magazine Lee-Enfields and on to the SMLE, the No.4 and No.5 Rifles as well as the Indian, Australian, American and Canadian

[17] The Small Arms Identification Series Pamphlets are best described as manuals for those collectors who want to know how to break down and reassemble their weapons whilst ensuring they purchase historically accurate spare parts. See I. Skennerton, .303 Rifle, No.5 Mk I – Parts Identification & Lists, No.5 Series Notes, Exploded Parts Drawings, Descriptions, Accessories & Fittings, (Ashmore City: I.D.Skennerton, 1993); I. Skennerton, .303 Rifle, No.4 Marks I, & I*, Marks ½, 1/3 & 2 - Parts Identification & Lists, No.4 Series Notes, Exploded Parts Drawings, Descriptions, Accessories & Fittings, (Ashmore City, Australia: I.D.Skennerton, 1993); I. Skennerton, .303 Rifle, No.1, S.M.L.E. Marks III and III*- Parts Identification & Lists, S.M.L.E. Series Notes, Exploded Parts Drawings, Descriptions, Accessories & Fittings (Ashmore City, Australia: I.D.Skennerton, 1993).

[18] I. Skennerton, The Lee Enfield Story - The Lee-Metford, Lee-Enfield, S.M.L.E. and No. 4 Series, Rifles and Carbines 1880 to the Present, (London: Greenhill Books, 1993).

variants. Skennerton includes short biographies of the engineers: William Ellis Metford, James Paris Lee and other members of the Royal Small Arms Factory (RSAF) who were involved such as Joseph Speed, John Rigby and Colonel Watkin. This aside, the body of this work makes extensive use of documents taken directly from the archive, quoting them in full in an attempt to explore the issues considered in the various designs of rifle. Where this approach fails is in explaining why these documents came about, who wrote them and on what basis they are relevant to the story. As a result *Lee-Enfield Story* fails to develop a more contextual understanding of the designs that would help establish how the weapons relate to user requirements.

The only other work on the Lee-Enfield family of weapons is called *The Lee-Enfield Rifle* by Major E.G.B. Reynolds, formerly an Inspection Officer with the Small Arms Inspectorate Department during the Second World War.[19] Less concerned with technical detail, this book spends a little more time drawing out the key phases in the design iterations of the Lee-Enfield rifles. These phases are then related to the wider historical situation by, for example, drawing attention to the way Boer War feedback affected design. As a result Reynolds demonstrates a greater awareness of context. However, by following a strict chronological order the narrative leaves open the suggestion that the Lee-Enfield family of rifles simply evolved on the basis of an inevitable technological trajectory. The human element is downplayed and this leads to the suspicion that the account assumes teleology in the rifle's design that a closer reading of history would not merit.

The only significant book on the EM2 is that by the late Thomas Dugelby, a former aeronautical engineer, gun collector and enthusiast. Dugelby, recognised by gun aficionados as an expert in his field, has produced two volumes on bullpup rifles: *EM-2 Concept & Design – a Rifle Ahead of its Time* and *Modern Military Bullpup Rifles*, both published by Collector Grade Publications, a significant and well recognised Canadian

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[19] E. G. B. Reynolds, The Lee-Enfield Rifle, (London: Herbert Jenkins, 1960).

publisher of books on small arms.[20] Whereas the former deals solely with the EM2, *Modern Military Bullpups* demonstrates how the original bullpup concept was taken and developed around the world. Accordingly *Modern Military Bullpups* shows how the idea for a shorter overall length of weapon with the trigger mechanism in front of the magazine was subsequently reproduced in rifles like the French F.A. MAS and the Austrian AUG *Sturmgewehr* 77.

Whereas *Modern Military Bullpups* shows how other nations took the bullpup design to heart, the very title of Dugelby's first book *EM2 Concept and Design – a Rifle Ahead of its Time* suggests that the British Army was not ready for a radical change from a weapon with a standard configuration to a bullpup layout. However, given the limited examination of the infantry's requirements little provision is made for showing how this may or may not have been the case. Accordingly, *Concept and Design* implies that the history of the EM2 is really the history of designers battling against engineering problems and a conservative military mindset. On this basis making use of documents taken from the archive and quoted without context or narrative makes perfect sense. For it seems that Dugelby's central contention is that the facts speak for themselves and require no further interpretation: designing a rifle is really just a case of getting the mechanics right. This is a problematic and deterministic way of looking at technology but *Concept and Design* invites such charges simply by failing adequately to situate technical decisions within a wider framework related to human choice.

There have been many press and gun enthusiast articles on the SA80 but the only book that has so far been published is that by Steve Raw, a former Royal Marine Armourer.[21]

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[20] T. B. Dugelby, EM-2 Concept and Design: a Rifle Ahead of its Time, (Toronto: Collector Grade Publications, 1980); T. B. Dugelby, Modern Military Rifles: the EM2 Concept Comes of Age, (Toronto: Collector Grade Publications, 1984).
[21] S. Raw, The Last Enfield: SA80 - The Reluctant Rifle, (Cobourg, Ont.: Collector Grade Publications, 2003). For press and enthusiasts' articles see for example: 'British Forces do Battle with Rifle Maintenance Mythology', Jane's International Defense Review, November 2002; James Meek, 'Off Target', The Guardian, 10 October 2002; B. Morrison, 'SA80 Heap of ####!', Combat and Survival, September 2000; General, Sir Peter de la Billier, 'Bargain Basement Army', Daily Mail, January 4 2000; T. Butcher, 'Commanders Attack Kosovo Failings', The Daily Telegraph, January 4 2000; M. Gilbert, 'The SA80 Assault Rifle: A Costly Disaster', Machine Gun News, April 1997, pp. 20-27; L. Thompson, 'The SA80 (L85A1) Individual Weapon', SWAT, February 1996, pp. 65-68; I. Kemp, 'MOD Handling of SA80

The Last Enfield - SA80 the Reluctant Rifle picks up the story of British bullpup design where Dugelby left off. In many ways this is a considerably more interesting and comprehensive work than the other Collector Grade materials. This is partly because Raw uses more narrative to explain his points but also, as he had some involvement in introducing the SA80 into service, he is more familiar with the weapon. The substance of the book tracks the chronology of changes to the SA80 from design to production. However, it goes further than this and attempts to explain why the weapon was introduced into service despite its initial failings. In identifying the source of these failures, *The Reluctant Rifle* takes sides, for example defending the RSAF design team from criticism and intimating that the problems with the SA80 were the result of bungling at the UK Ministry of Defence. Raw does not, however, make the argument stick. There are two reasons for this. The first is that the *Reluctant Rifle* does not identify with sufficient clarity the various actors involved and therefore the basis for introducing the SA80 into service cannot be accurately analysed. The second is that the book is also a manual for enthusiasts collecting the various types of magazine, bayonet fitting and cleaning kit. Given the number of pages dedicated to these matters the reader is left thinking that weapon development is really a matter of solving a series of engineering problems accommodated within a programme of rifle design. As a consequence, the *Reluctant Rifle* suggests that the SA80 had a trajectory towards adoption that was in some way autonomous, inevitable and, even accounting for supposed bureaucratic incompetence, unavoidable.

Buy Berated', Jane's Defence Weekly, 31 July 1993, p. 26; J. Deans, 'Gulf Gun Broadside', The Daily Mail, 25 June 1993; 'Fusiliers Delighted with SA80', Soldier, 23 March 1992; J. Stevenson, 'Service Rifle Scandal', Handgunner, 1993, pp. 22-29; C. Kirby, 'Cassandra and the Rifle', Handgunner, Feb/Mar 1993, pp. 34-53; C. Macrae, 'Falklands Rejects Britain's "Junk Gun", The Observer, 20 August 1992; C. Macrae, 'Revealed: MOD told in 1985 New Rifle was a Dud', The Observer, 23 August 1992; A.J. McIlroy, 'Gulf Troops "Feared Rifle would not Fire"', The Daily Telegraph, 22 August 1992; C. Macrae, 'Secret Report Damns Army's Assault Rifle', The Observer, 16 August 1992; 'More Changes to the SA80', Jane's Defence Weekly, 9 June 1990; G. Willis, 'The Long and the Short of it – the SA80 Weapon Family', International Defense Review, January 1989, pp. 65-68; 'Firing the SA80; The British Army's New Combat Rifle', Soldier of Fortune, September 1987, pp. 46-51; J.R. Tate, 'Bullet Dumps its Lethal Energy most Efficiently', Soldier, 6 October 1986; R.C. Waddington, 'Stop Knocking the SA80', Soldier, 6 October 1986; 'SA80 Rifle Design "Faulty"', Soldier, 8 September 1986; E.R. Hooton, 'The Enfield Weapon System: New Small Arms for the British Army', Military Technology, March 1986, pp. 120-128; N. Steadman, 'The Enfield Weapon System', Armed Forces, Vol. 5 (1986), No. 2, pp. 71-75; G. Manners, 'Left Handed Recruits may be Turned Away', Jane's Defence Weekly, 19 October 1985.

What a review of the literature reveals is that the enthusiasts' excessive zeal for the hardware ensures that human agency in rifle design is obscured. Instead there is the suggestion that these artefacts evolve according to a set of principles located within the weapon itself. Thus, a rifle develops along its trajectory as engineering problems are smoothed out: successive iterations of the weapon ensuring that it eventually reaches its ideal form. That this is a highly deterministic way of seeing firearm design is clear. The question that needs to be addressed is how to put social context back into a story of technology.

The Social Construction of Technology

This thesis seeks to avoid technological determinism by demonstrating how decisions about the design of firearms are the result of human choice and not engineering imperatives. This is achieved by locating the development of small arms within the structures of meaning created by those actors and social groups who have an interest in these weapons. There are a number of ways in which this might be achieved that look at the matter from an economic or management point of view but the approach adopted here is to apply techniques associated with a particular type of SST literature known as the Social Construction of Technology (SCOT) to the study of British infantry rifles.

SCOT represents a fundamental shift in academic thinking with regards to technology studies over the past twenty years, supplanting some other modes of study found in economics, political science or business studies.[22] Its advantages are several-fold. In the first place the method that underpins SCOT connects the technical artefact to its social context. Central to this is the notion that different groups have different perceptions of a particular technology: what problems need to be solved and how this might be achieved. In the case of the rifle various parties will potentially want the weapon do a number of

[22] SCOT is one school of thought that falls within an approach to technology known as the Social Shaping of Technology. For an overview of the literature see MacKenzie and Wajcman (eds.), The Social Shaping of Technology: How the Refrigerator Got its Hum; R. Williams and D. Edge, 'The social shaping of technology', Research Policy, Vol: 25, No: 6 (1996). The field's core journals include *Social Studies of Science*, *Technology and Culture*, and *Science, Technology and Human Values*. SST articles can also be found in *Sociological Review*, *Research Policy*, *Social Problems*, *Technovation*, *Technology Analysis and Strategic Management*, and *Isis*.

things for them. These need not be limited to matters associated with infantry combat. Other institutional or political issues may be of importance. And this is where SCOT can be particularly valuable. By focusing on what a rifle means for the actors the method highlights ways in which a number of apparently diverse issues relate to each other. Consequently it becomes possible to show how wider organisational concerns knit together with questions related to battle. As a result the magazine rifle is put in a completely new light. In the first place the weapon becomes a mechanism for exploring the beliefs, values and assumptions held by a number of different actors who have an interest in military-technical change. At the same time the relationship between the way battlefield problems are perceived and how the Army chooses to fight becomes clearer.

The starting place for a SCOT approach to technology is derived from the Empirical Programme of Relativism (EPOR) originally explored as part of the Sociology of Scientific Knowledge (SSK).[23] EPOR's central assertion is that it is important when investigating the causes of a belief, that one should be impartial to the subsequent truth or falsity of that belief.[24] On this basis the commentator must take a robust approach to historical data making sure to follow the path dependence of ideas within communities. Only when a belief becomes an accepted part of a social group's structures of meaning can it be considered scientific knowledge and success attributed to it. Up until that time all the various ways of seeing a problem, solution or idea must be treated as if they have an equal chance of becoming an accepted truth. Thus, when seeking to understand why a particular community holds one belief to be true the researcher must keep in mind the possibility that the world might have been seen and understood differently.

EPOR underpinned the empirical research produced by SSK. This demonstrated that scientific theories were only considered to form part of the accepted body of knowledge when a consensus developed among scientists who agreed this to be the case. Buttressing the process was the existence of a scientific community whose members understood the

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[23] W. E. Bijker, 'Social Construction of Facts and Artefacts', in The Social Construction of Technological Systems, Wiebe E. Bijker, Thomas Hughes and T. Pinch (eds.), (Cambridge, Mass.: MIT Press, 1989), p. 28.
[24] Ibid., p. 18.

need for experiments that generated reproducible results central to the scientific method and the use of peer review to assess the verisimilitude of particular claims. The evidence produced by SSK suggested that a scientific theory had to traverse three steps if it was to become knowledge. In the first stage scientific findings were open to more than one interpretation, i.e., that they were interpretively flexible. In the second stage a social mechanism worked to limit the interpretive flexibility of an experiment so that agreement could be reached about what the results constituted. In the third stage these closure mechanisms were related to a wider socio-cultural context.[25]

For Wiebe Bijker, the chief proponent of SCOT, the SSK findings looked as if they had some application to the field of technology studies and he sought to establish how this might be the case. By examining the design history of the Victorian safety bicycle, Bijker showed that the way technical items are developed is essentially contingent on any number of human choices. Claims that bicycles followed a linear development cycle from poor to more advanced types did not stand up.[26] Indeed, Bijker established that at the end of the 19th century there were in fact many forms of bicycle that might have become successful. Some endured whilst others died out. That the Victorian Safety Bicycle became the accepted standard was not an inevitable result of product improvements: the Penny Farthing did not lead directly to the Safety Bicycle. On the contrary, the evidence demonstrated that the selection processes associated with bicycle design were really multi-directional.[27]

What Bijker's research showed was that the symmetry of explanation principle found in SSK had direct relevance in a technology context. Different problems were defined by different social groups who advocated different designs. In the case of the Safety Bicycle, there were three relevant social groups. Women and older men were two demographics that wanted a bike with a lowered centre of gravity. Older men wanted it because it would be easier to use. Women wanted it because it would be more appropriate for them to ride given the social requirement for female decency. The third

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[25] Ibid., pp. 26-28.
[26] Ibid., pp. 31-37.
[27] Bijker, Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change, p. 53.

group, identified by Bijker to be 'macho men' wanted speed; a solution that previously had been provided by bikes like the Penny Farthing. In the Safety Bicycle, however, all three groups found a solution to their respective problems. Women and older men got safety and moral decency. Macho men came to realise that chain driven, rear-wheel drive bicycles with inflatable tyres could go faster than their previous favourite, the high wheeler bike. In this respect the safety bicycle was interpreted flexibly.[28]

When it came to identifying closure mechanisms Bijker could demonstrate that the programme outlined in SSK also had some relevance to technology. That all three social groups could eventually agree on what constituted the most appropriate bicycle design, was a matter of seeing the solution to different socially defined problems in one version of the bicycle. This was not achieved in a short period of time. Rather, the activities of bicycle companies marketing their products eventually shaped the language used by the various groups in such a way that they no longer believed there to be a problem worth resolving. Bijker argues that this represented a rhetorical closure mechanism.[29] This was reinforced by the protagonists themselves who realised that their initial objections to the Safety Bicycle no longer applied because there was a significant advantage to be gained by moving to the new design. For Bijker this demonstrated how some of the protagonists redefined their technology problem.[30] Both rhetorical closure and closure by redefining the problem made it possible for a particular technology, in this case bicycles, to stabilise and connect to a wider socio-cultural context.

The SCOT approach as formulated above has many attractive features, one of the main being the simple process it follows to determine how a technology stabilises in practice. The first step is to identify those groups who have a view on the technology concerned. The second step is to identify what they think about the technology: what they want it for, what they need it to do. The third step is to find out whether they believe there are problems with it. If they do not have a problem then the technology progresses to closure. On the basis that there is a problem, the fourth step is to show how arguments

[28] Ibid., pp. 73-77.
[29] Bijker, 'Social Construction of Facts and Artefacts', p. 44.
[30] Ibid., p. 44.

were deployed by the various relevant social groups to see whether a resolution could be achieved. Providing that either a technical solution has been reached or problems have been re-defined, the last step is to show how the design stabilises. The key is to recognise that one technical artefact can mean different things to different groups. As Bijker would say, it has 'interpretive flexibility'.[31]

A number of criticisms have, however, been levelled at SCOT the most corrosive of which has been that developed by Langdon Winner. Winner writes,

> I believe it is necessary for social theorists to go beyond what positivists used to call *value neutrality* and what social constructivists resurrect as *interpretive flexibility*. One must move on to offer coherent arguments about which ends, principles, and conditions deserve not only our attention but also our commitment.[32]

Winner argues that SCOT fails to take a political and ethical stance on the choices involved in technology design and use. Its inherent constructivism may indeed provide the tools by which it is possible to understand the various narratives of the relevant social group but it does not tell us what is right or wrong, good or bad. And in this respect current technology studies are empty because they do not tell us how we ought to act. The extent to which a constructivist can contribute to policy debate is, therefore, questionable given that their fundamental mode of analysis is, to a greater or lesser extent, concerned with how power shapes and is shaped by technical artefacts rather than taking a moral stance.

However, in regards to a study of infantry rifles such a situation has its advantages. Normatively speaking, weapons technologies are ethically controversial and in this context could close down an SST analysis of rifle design. By taking a constructivist line of reasoning the moral issues associated with the choices made about rifles are sidelined

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[31] Bijker, Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change, p. 73.
[32] L. Winner, 'Upon Opening the Black-Box and Finding It Empty - Social Constructivism and the Philosophy of Technology', Science Technology & Human Values, Vol: 18, No: 3 (1993), p. 374.

so that the interests and concerns of the relevant social groups can be examined. That is not to say that a moral debate about the appropriateness of the technology should not occur, but rather that this debate ought not to be used to pre-judge a socio-technical history of the rifle.

A less philosophical criticism of SCOT is concerned with the failure to take into account how difficult it is to identify appropriate closure mechanisms when relevant social groups do not have a shared outlook on the world. In SSK a wider scientific peer group works to agree on closure, for example, by publishing articles in respected scientific journals. The scientific community has a shared language, methodological outlook and way of looking at the world. But in SCOT as Russell observes, a common bond or set of agreed cultural dispositions is not necessarily in place between relevant social groups.[33] Identifying appropriate mechanisms that make it possible to achieve closure is therefore potentially more challenging.

A third criticism stems from SCOT's suggestion that the innovation process itself is un-problematic.[34] The argument is that SCOT does not necessarily reflect the reality of technology design and importantly ignores the issues of power relations between individuals and relevant social groups. SCOT fails to take into account the fact there could be significant conflict between various social groups, which in turn obstructs consensus building.[35] If this was the case it would not be possible to achieve the conception of closure outlined by Bijker. No agreement between the parties could be reached and depending on how power was distributed, one group might be forced to accept a solution it did not believe to be appropriate.

In a military setting there is clearly an opportunity to show that the above critiques apply wholeheartedly. Power relations are such that at first glance it would appear that the

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[33] S. Russell, 'The Social Construction of Artefacts - a Response to Pinch and Bijker', Social Studies of Science, Vol: 16, No: 2 (1986), p. 337.
[34] Vergragt, P., 'The Social Shaping of Industrial Innovations' Social Studies of Science, Vol.18 (1988), pp.483-513.
[35] M. Hard, 'Beyond Harmony and Consensus: A Social Conflict Approach to Technology', Science Technology and Human Values, Vol. 18 (1993), No. 4, pp. 408-432.

infantryman's lot is to accept what others give him. It is appealing to think that in a military command structure senior officers give instructions and make decisions that more junior ranks have to accept and implement. However, in the context of developing British military technology little or no evidence is available to demonstrate that this is empirically the case. It is therefore an unproven assumption that the user does not have a voice in the technology selection process.

There is then an evidential gap that this thesis seeks to close. The method chosen to investigate this originates with SCOT: the intention being to establish whether such an approach to technology selection has any application to rifle development in the British Army. Bearing this in mind it is necessary to follow the programme's broad outlines, identify the key actors, their interests and their views on each weapon. This will make it possible to examine within their appropriate social contexts the meanings associated with each. Having done this, the various closure mechanisms referred to in the SCOT methodology can be more thoroughly examined and, if appropriate, adopted or adapted to the British military setting.

SCOT is a post-positivist approach to technology innovation, concerned with showing that the decisions to design, build and adopt technical items are primarily those of situated relevant social groups. As SCOT is the underlying basis for exploring rifle technology, a qualitative, case study method in relation to the empirical data has to be adopted. This thesis, like the SCOT programme itself, will emphasise context with a view to exploring the various social choices made in connection with these particular rifles. By its very nature, this involves interpreting the web of relationships that exist in relation to the design process in order to develop an understanding as to how the LEME, SMLE, EM2 and SA80 came into existence. Nevertheless, whilst SCOT shapes the initial methodological approach it is not applied rigidly. Rather this literature can best be seen as a way of providing the sensitising concepts that help to frame research into rifle design.

Sources

The number and quality of secondary source materials available on British magazine rifles has already been shown to be limited. This thesis does therefore need to make a greater use of primary sources for the SCOT approach to be undertaken effectively. The majority of primary sources come in the form of archival documents such as committee minutes, reports and 'in/out' correspondence. These records have mainly been drawn from three locations: the archive of the former MoD Pattern Room, now known as the National Firearms Centre in Leeds; the Shephard Archive at the Laurier Centre for Military Strategic and Disarmament Studies (LCMSDS) at the Wilfred Laurier University in Canada; and the National Archive at Kew in London.

Each of these repositories provides slightly different types of material. The documents found in Leeds, for example, are mainly technical in nature and relate to the various weapon development programmes being undertaken either by the RSAF or the small arms design establishment. This compares with the Shephard Archive which contains a large quantity of data on operational research in small arms and tactics. The National Archive at Kew is home to higher-level materials that connect the various small arms departments and establishments to the wider bureaucratic organisations that have had some involvement in weapon design. Between the three repositories it is possible to trace the correspondence, committee minutes and reports produced between the various relevant social groups involved in ordnance design, development and production. Additionally a number of other resources have been examined so as to flesh out the EM2 case study. The most useful were the Zuckerman Collection at the University of East Anglia, the Library and Archives Canada in Ottawa and the Cherwell Papers, at Nuffield College Oxford.

In contrast to the LEME, SMLE and EM2 case studies, researching the SA80 has proven to be particularly challenging. With a version of the rifle still in service permission to examine the official archive was not granted. However, materials produced about the Enfield Weapon System, the prototype SA80, developed before the 1979 North Atlantic Treaty Organisation (NATO) ammunition standardisation trials have been consulted.

This was possible because this weapon fired ammunition that never entered into service. Documents produced after the NATO trials have not been declassified. Of the materials that are available for viewing, some insights can be gained into how the rifle was designed, developed and procured. Unfortunately, however, they do not provide anywhere near as much detail as might be required for meaningful interpretation. It has therefore been necessary to undertake a number of interviews with various people involved in the project. Identifying these people has been aided by involving the custodian of the Small Arms School Weapons Collection and the General Secretary of the Officers Association who helpfully provided access to a number of key individuals.

Chapter structure

In the next six chapters all four rifles are examined chronologically and in turn. Because the LEME, SMLE and SA80 were successfully adopted the process by which the design of these weapons stabilised was comparatively straightforward. Thus chapters two, three and seven are dedicated to examining respectively the LEME, SMLE and SA80. The EM2, however, was adopted and then abandoned and as a result the story associated with its development is considerably more convoluted. There will therefore be three chapters (chapters four, five and six) on this case study.

In chapter two, the key social groups relevant to the LEME story are identified. In particular, the views of the Commander-in-Chief, the Duke of Cambridge, the Adjutant-General, General Wolseley, the Admiralty and Lieutenant-Colonel Slade, Commanding Officer of the 2nd Battalion the Rifle Brigade are explored. Traditionalists such as the Commander-in-Chief, the Duke of Cambridge, wanted to continue to fire shots in volleys by rank. The Royal Navy, by contrast, was interested in a weapon that would enable its Marines to repel boarders and engage an enemy located in the fighting tops of ships. Imperialists like the Adjutant-General, General Wolseley, recognised the need to adopt skirmishing tactics but were wary of the logistical implications that stemmed from a magazine rifle. Finally, in Slade's view the light infantry wanted a rifle that would allow them to match the fire capabilities of the heavy infantry. Having examined the perspectives of each of these actors on battle it then becomes possible to understand why they emphasised certain technical solutions over others. Consequently, the final part of this chapter examines the way in which these differing views manifested themselves in the design of the LEME.

Similarly, in chapter three the relevant social groups and their interests in the development of the SMLE are explored. Particular attention is paid to Field Marshal Roberts and Colonel Ian Hamilton, two former Indian Army officers crucial to the development of the SMLE. In relation to battle shooting, the perspective of both men had been conditioned by their experience of fighting on the North West Frontier. These views were further entrenched whilst fighting the Boers during the Second Boer War. Upon their return to Britain they were then in a position to implement their vision. However, the Boer War also brought to prominence a second group, identified here as the cavalry school, who also had an interest in the development of firearms suitable for their role and ethos. Finally, a third group made up of members of the National Rifle Association and prominent politicians also had something to say about small arms. Lacking expert knowledge, the problem facing this final group was that none could mount an effective challenge to a consensus that had already formed within the Army with regards to the SMLE.

Compared to the previous two chapters, the EM2 case study is slightly different. The main reason for this is that it is necessary to explain the way in which the British Army decided to adopt the EM2 and then subsequently abandon it. Chapter four is therefore concerned with identifying the three key protagonists responsible for developing the EM2 solution. In particular the views of the Director of Infantry, the Armament Design Establishment and the Director of Artillery/Director of Artillery (Small Arms) are examined. What emerges is how each of the three groups, described here as the EM2 advocates, had a view of the battlefield which stimulated the development of a uniquely British weapon to replace the Sten machine carbine and the No.1 and No.4 Rifles.

Chapter five is a pivotal chapter in that it explores both how the EM2 advocates made their case for change at the War Office and why the technical solution they suggested took the form that it did. The chapter is divided into two parts. The first discusses the ammunition solution, paying particular reference to how it had to satisfy both the requirements of the infantry, as defined by the EM2 advocates, and the General Staff's ambition to achieve standardisation with the United States. Part two explores the rifle solution with a view to demonstrating how a number of sceptics at the War Office had to be persuaded to accept an automatic rifle. What becomes clear is that the view of the battlefield that the EM2 advocates had developed was not universally accepted by the General Staff. As a result a number of concessions needed to be agreed before the weapon became acceptable.

Chapter six brings the EM2 story to its conclusion. With the War Office in agreement about the nature of rifle they wanted to replace the SMLE, the EM2 advocates took their case to the US Army in an attempt to bring about ammunition and weapon standardisation on UK terms. As the Americans represented a major obstacle to the EM2 advocates, the first part of this chapter is concerned with exploring US attitudes towards small arms, specifically by focusing on their views on marksmanship, .30'06 ammunition and the M1 Garand. What becomes evident is that the US Army had a significantly different perspective on infantry combat, one which revealed itself not only in the design of small arms but also at a more fundamental level related to the science of wound ballistics. By itself, however, the outlook of the Americans would not necessarily have led the War Office to abandon its ambitions to procure the EM2. Rather, it was the re-election of Churchill in October 1951 and the concerted efforts of the Canadian and French governments that brought about a situation in which the EM2 advocates had to accept that their solution was not acceptable to the wider community of interests. The role played by this group of actors does therefore constitute the mainstay of the second half of this chapter. Finally, as the British Army ultimately selected *Fabrique Nationale's* conventionally configured *Fusil Automatique Léger* (FAL) in 1957, the role played by this Belgian company is discussed last.

Chapter seven is concerned with the Section Small Arms Post 1980. The structure of this chapter is necessarily different from the proceeding three case studies. This is mainly due to the difficulty caused by the lack of primary source materials. Unable to name categorically all the protagonists involved, this chapter is structured to show how a debate at the Ministry of Defence most probably unfolded. In the run up to the selection of the SA80 there were three potential design solutions, each reflecting a different interpretation of the battlefield. British involvement in Borneo during the 1960s not only shaped the decision to issue the M16 to units serving in the jungles of the Far East but also conditioned attitudes towards ammunition design going into the 1970s. Northern Ireland subsequently played a significant part in shaping the Army's thinking on discriminate shooting, accuracy, training and tactics and left engineers in the small arms community working on a new design of ammunition and rifle appropriate for low intensity operations. Finally, the British government's commitment to NATO and the need to maintain a credible conventional response to the Soviet military threat led to a realisation that the Army needed to work within a procurement and doctrinal framework that took into account the importance of its allies. Each of these situations could have produced a different solution. That they did not suggests that the Section Small Arms Post 1980 was agreeable to a number of different constituencies who could find what they needed in the new system.

Chapter eight constitutes the conclusion. This not only draws together the main themes from the previous seven chapters but demonstrates how this approach to technical artefacts might be taken in different directions and expanded into other areas of study.

Chapter Two - The Lee-Metford (LEME) Magazine Rifle

In 1888 Edward Stanhope, the Secretary of State for War, agreed to replace the single-shot Martini-Henry and accept the magazine-fed Lee-Metford into service with the British Army.[1] With the Germans adopting the Mauser in 1881 and the French selecting the Lebel in 1888 the decision, at least according to some commentators, appeared to fit a pattern of technical choices being made across Europe.[2] Magazine rifles made it possible for the soldier to reload quickly and thereby increase the quantity of fire generated. The battlefield was potentially a more dangerous place as a result. Armies that could not keep up with the technical state of the art could expect to suffer defeat and humiliation.[3]

A closer look at the evidence shows that the British Army's decision to adopt the LEME was, however, neither easy nor inevitable. The magazine rifle provoked serious argument among various groups within the War Office making it extremely difficult to forge a consensus on what ought to replace the Martini-Henry. This failure to reach a quick agreement was not, as some have suggested, driven by a sentimental or wilful desire to avoid facing the firepower realities produced by new technologies.[4] Rather there were sound reasons for a cautious approach. Could the rank and file be trusted to make effective use of their rifles? If survival on an increasingly dangerous battlefield meant a greater dispersal of troops, how would officers exercise command and control over their men? If ammunition could be fired more quickly how would the supply chain cope with greater demand?

As this chapter will show, to argue that technical changes in the British Army were being determined by firepower imperatives derived from technology improvements is to misrepresent the views of those concerned with the selection of the LEME.

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[1] See List of Changes, LC. 5877, MOD Pattern Room Archive.
[2] Strachan, European Armies and the Conduct of War, pp. 113-114.
[3] Ibid., p. 115.
[4] J. Ellis, The Social History of the Machine Gun, (London: Pimlico, 1976), p. 171 and p. 175; a similar line of argument is advanced by Anthony Smith, see A. Smith, Machine Gun: The Story of the Men and the Weapon that Changed the Face of War, (London: Piatkus, 2002), pp. 173-182.

Neither the conservatives at the War Office nor those experienced in colonial warfare were interested in generating more fire if that sacrificed command and control. The traditionalists such as the Duke of Cambridge, for example, considered that troops armed with a magazine rifle could potentially undermine the careful balance of relationships that existed between a company officer and his men.[5] At the same time, the imperialists like General Wolseley, were hardly eager to adopt a magazine rifle either; for even though they believed that the men could be trained to cope with the command problems caused by a chaotic battlefield, weapon reliability and logistical considerations were even more important to them than increased rates of fire. For a number of different reasons, therefore, it seemed that both groups were reluctant to replace the existing single-shot rifle.

That said, significant pressure to abandon the Martini-Henry and adopt a magazine arm still existed. Certainly, without the determined effort of the Director of Naval Ordnance (DNO) throughout the 1880s, it is unlikely that the Army would have adopted a magazine rifle when it did for the War Office could not ignore the Royal Navy's constitutional power to purchase small arms appropriate for its own needs. As a result the Navy's insistence on replacing the Martini-Henry kept the issue of the magazine rifle alive despite the best efforts of some members of the Army to bury the idea.

However, it was the appointment of Lieutenant-Colonel Slade to the Small Arms Committee reviewing magazine rifles that gave the Rifle Brigade a platform to push for an even more radical vision of the battlefield.[6] If Slade's views were embraced then the skirmishing, independent-firing light infantry might generate as much fire as the regiments of the line who shot in closed rank and by volley. If on top of this a potential enemy adopted a magazine arm as well, the traditionalists would then face the possibility of having to re-train the heavy infantry regiments in open order tactics

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[5] The traditionalist and imperialist categorisation is derived from an article by Howard Bailes. See, H. Bailes, 'Patterns of Thought in the Late Victorian Army', Journal of Strategic Studies, Vol: 4, No: 1 (1982).

[6] Lieutenant-Colonel Slade was Commanding Officer, 2nd Battalion of the Rifle Brigade.

so that they could survive a more dangerous battlefield. So long as the government remained committed to defending the Empire in situations where the enemy did not have access to rifle technology this would not be a problem. All the same, if Britain should be committed to fight on the continent or against a colonial foe armed with similar weapons then the existing state of officer-man relations might have to change. As far as the traditionalists were concerned the Rifle Brigade's commitment to a magazine arm was the thin end of the wedge; a wedge that presented a challenge to the way that the rest of Army was commanded.

It would be fair to say, therefore, that the military possibilities created by a magazine rifle posed a number of difficult and intractable problems that had more to do with officer-man relations, command and control, logistics and reliability than with increasing the infantryman's rate of fire. If the traditionalists were to accept the new rifle technology then some way of limiting what they believed were its pernicious organisational tendencies had to be found. However, if the advocates were to be successful then they had to go beyond their own particular needs and views of the battlefield and address the concerns of those who thought this new weapon was potentially too organisationally disruptive. By exploring the views of the various protagonists, this chapter shows how consensus was created through the application of a number of technical contrivances designed to constrain the LEME's rate of fire.

Before proceeding to identify the various relevant actors and their views on small arms, it will be helpful to provide a word of explanation with regards to the various rifles discussed over the next two chapters.[7] In particular it is necessary to describe the two breech-loading actions that are regularly referenced in what follows. The Martini-Henry was a single-shot weapon. This meant that a single round had to be loaded into the chamber by hand and removed once it was spent. On the Martini-Henry the cocking of the striker and the extraction of a spent cartridge was achieved by pushing a lever underneath the butt of the rifle. The breechblock would then swing downwards thereby opening the breech and actuating an extractor claw which

[7] See appendix 1 for images of the respective weapons.

partially ejected the rimmed cartridge from the chamber. The soldier then had to use his fingers to remove physically the spent cartridge case. When a new round was placed in the chamber and the lever depressed to close the breech, the striker would be in the appropriate cocked position and the weapon would be ready for firing.

In contrast the LEME was a bolt-action magazine-fed rifle that obviated the need for the soldier to load single rounds into the breech of the weapon. Instead the soldier could draw rounds up from a reserve of ammunition located directly underneath the receiver of the rifle.[8] As a result the soldier would only need to reload the magazine when there were no more rounds located within it. The LEME had a breech-action involving a bolt sliding within the receiver so that its head sealed the firing chamber. By using an attached lever to turn the bolt 60 degrees and pulling it backwards, an extractor claw would remove and eject a spent cartridge. At the same time the striker, which was located within the bolt itself, would be reset and cocked. As the bolt was pushed forwards a new round would be drawn from the magazine, inserted into the firing chamber and the striker retained in the cocked setting. The bolt was locked in its firing position by rear-mounted lugs which would ensure the breech remained sealed when a round was fired.

The Traditionalists

What differentiated the traditionalists of the 1880s from all the other relevant social groups connected with the selection of the LEME was their attitude towards close order formation, command and control and volley fire. At the more conservative end of the traditionalist group were officers, such as the Duke of Cambridge, who

[8] In the history of the LEME and the SMLE it should be noted that there was also a version of the LEME that fired smokeless ammunition. This new weapon was known as the Lee-Enfield and was first introduced into service in October 1895 (See List of Changes LC. 8118, MOD Pattern Room Archive). Whilst the breech mechanism for both weapons remained the same, the difference between the LEME and the Lee-Enfield can be put down to the fact that smokeless propellants wore out LEME barrels too quickly. This forced the War Office to use Enfield rifling rather than that created by William Metford. The LEME did, however, remain in service whilst sufficient stocks of Lee-Enfield were built up for distribution to troops. In a sense then the SMLE replaced both the LEME and the Lee-Enfield at the same time. There are several socio-technical reasons for the change from LEME to Lee-Enfield but this is discussed as part of the subsequent chapter. Until that point the convention adopted here is to write about the SMLE as though it replaced the LEME.

could be caricatured by their dislike of the Caldwell Reforms.[9] These reforms were designed to replace the old regiments of the line with county regiments made up of short service recruits. With one battalion from these new organisations posted overseas in defence of the Empire and the other remaining in Britain, the system was designed to create an Army reserve to be called out in emergency. Because it did away with long service and started the process of professionalising the officer corps it was not welcomed by those conservatives wedded to more time-honoured methods. At the other end of the traditionalist spectrum of views were the Europeans who believed that the Army ought to measure itself against and prepare to fight its potential French or German enemies.[10] Typified by men such as Captain C.B. Mayne, this progressive group was less distrustful of short service and the Army reserve but more concerned by the problems caused by linking battalions for colonial service. Despite their differences, however, both factions viewed the battlefield implications posed by new technology in similar ways.[11] Their attitudes with regard to how to respond from a technical perspective were slightly different but their tactical schemes were broadly aligned. In this respect what distinguished the progressive from the conservative was the fact that the Duke of Cambridge, as the Commander-in-Chief, was in a better position to effect organisational change. In what follows the nuances of the traditionalist's point of view on small arms and minor tactics are examined in more detail.

After having commanded the Guards' Division during the Crimean War where he displayed, '...personal courage but only mediocre military talent', the Duke of Cambridge became the Commander-in-Chief in 1856.[12] As the Queen's cousin the Duke often communicated with the Royal Household on military matters. However, following the War Office Act of 1870 the Commander-in-Chief had to accept subservience to Parliament and console himself with trying to prevent further reforms which might undermine an institution he clearly cherished. Whilst

[9] Bailes, 'Patterns of Thought in the Late Victorian Army', p. 34.
[10] Ibid., p. 34.
[11] Ellis, The Social History of the Machine Gun, p. 51; C.B. Mayne, 'Infantry Fire Tactics Suitable to the Canadian Militia', Canadian Military Institute, (1890), p. 15.
[12] B. Bond, 'The Retirement of the Duke of Cambridge', JRUSI, Vol: 106, (1961), p. 544.

Cambridge was most definitely conservative when it came to civil-military relations and questions concerning the Army's organisation his views according to the Adjutant-General, Lord Wolseley were at least driven by higher ideals. Indeed, whereas the Queen recognised in 1890 that he could be 'retrograde and reactionary' Wolseley described him as, 'Educated to believe in the Army as he found it, because it had been made by the great Duke of Wellington, he honestly and firmly believed that what had been created by such a master of war must be the best for all time'.[13]

Heartfelt commitment to the Army aside, Cambridge's view of the battlefield was conditioned by the fact that he had been deskbound since the Crimean War. Without experience of the types of colonial campaigns being fought in the second half of the nineteenth century, his tactical views were concerned with rigidly implementing the textbook approach to fire discipline and fire control.[14] This did not mean that he was against the use of firepower but that, as official drill stated, 'It cannot be left to individual initiation without the danger of its degeneration into a useless expenditure of ammunition'.[15] There were a number of good reasons for this approach. At a practical level, discharging several rounds of black powder ammunition in a short period of time would obscure the enemy making it hard for an officer to direct fire.[16] This would make it difficult to determine what target was the most important which in turn might prevent a unit from carrying out the instructions of higher authority. Accordingly, if order was to be maintained and generals given the opportunity to achieve their objectives, fire had to be controlled. For the traditionalists the best way that troops could be kept in hand was if they were close together or better still in shoulder-to-shoulder formation.[17] This would keep officers and men in close proximity allowing fire orders to be transmitted easily down the chain of command. At the same time, by firing in and taking pauses between volleys the smoke could

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[13] Ibid., p. 544.
[14] 'Trial of Magazine Rifles in Britain from 1879', p. 32, MOD Pattern Room Archive.
[15] Field Exercise and Revolutions of Infantry, (London: HMSO, 1884), p. 307.
[16] J. W. Malet, Handbook to Field Training in the Infantry – in accordance with the revised syllabus contained in the new Infantry Drill, (Chatham: Gale & Polden, 1891), p. 63.
[17] Mayne, 'Infantry Fire Tactics Suitable to the Canadian Militia', p. 13.

clear from the front making it easier to correct for elevation and direction whilst regulating the expenditure of ammunition.[18]

By contrast, individual fire was to be avoided at all costs.[19] There were several reasons for this, all mainly derived from the doubt officers felt about the educational achievements of their men.[20] Viewing them as 'helpless and careless...[and] to be treated like a child' it was not clear whether the men would be capable of picking out the most valuable military targets, deciding on the range to engage the enemy or ensuring that their activities complied with orders unless given explicit instruction.[21] Soldiers who used their weapon independently increased the chances of a ragged and continuous fire which made it hard for instructions to be heard. The upshot of this was that officers did not believe that, in the heat of battle, the rank and file could control their emotions sufficiently to avoid wasting all their ammunition. Individual fire was consequently viewed as useful only if it could be, '...stopped and taken up again instantaneously at the will of the Commander'.[22]

The School of Musketry reinforced these messages in its curriculum.[23] To pass the School's Extra Certificate, a course which was available only to officers, it was essential to have read various chapters from C.B. Mayne's *Fire Tactic*.[24] The central theme of this book, and indeed his writings in general, was the maintenance of fire discipline and control by officers over their men, preferably by the use of close order formation, volley-fire and the avoidance of unnecessary mixing of subordinate

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[18] Field Exercise and Revolutions of Infantry, pp. 308-309.
[19] Mayne, 'Infantry Fire Tactics Suitable to the Canadian Militia', pp. 5-6.
[20] D. French, Military Identities: the Regimental System, the British Army, and the British People, c.1870-2000, (Oxford: Oxford University Press, 2005), p. 108; M. A. Ramsay, Command and Cohesion: the Citizen Soldier and Minor Tactics in the British Army, 1870-1918, (Westport, Conn.: Praeger, 1999), pp. 61-62; in a slightly different context Gary Sheffield makes the same point, see G. D. Sheffield, Leadership in the Trenches: Officer-Man Relations, Morale, and Discipline in the British Army in the era of the First World War, (Houndmills, Basingstoke, Hampshire: New York : Macmillan ; St. Martin's Press, 1999), pp. 68-69.
[21] French, Military Identities: the Regimental System, the British Army, and the British People, c.1870-2000, p. 108.
[22] Field Exercise and Revolutions of Infantry, pp. 307-308.
[23] For an examination of the curriculum at the School of Musketry see W. S Miller, The School of Musketry at Hythe, (London: William Clowes and Sons, 1892).
[24] C. B. Mayne, Infantry Fire Tactics, 2nd edn, (Chatham: Gale & Polden, 1888).

units.[25] In this respect the Martini-Henry only served to underline physically the importance of these ideas to all members of the infantry company. For as a single-shot rifle, the Martini-Henry required the soldier to load, fire, extract and reload ammunition as he was engaging with the enemy. All these activities were extremely obvious to those in charge of infantrymen especially if troops were in close order or 'locked up' formation.[26] The rank and file could therefore be directed to fire in volleys at the most important targets as defined by a commanding officer.

Conversely, if a soldier was provided with a magazine rifle the need to reload from a pouch was suppressed.[27] This could potentially undermine the fine balance of relationships that existed between officers and the ranks making it harder to maintain what one commentator has described as 'restrictive control'.[28] This was because it was difficult for officers and NCOs to monitor how many rounds had been fired from the magazine whilst making it easier for soldiers to fire from this reserve without fear of disciplinary action.[29] The result could be an unnecessary wastage of ammunition that undermined the ability of the officer to achieve his military objectives.

Such an attitude towards fire control helps to explain why the Duke of Cambridge was so reluctant to move from the Martini action. In October 1880, the Director of Artillery and Stores asked the Surveyor-General of Ordnance whether it was necessary to investigate adopting an improved version of the existing weapon.[30] With the permission of the Secretary of State and the support of the Commander-in-Chief a new Special Small Arms Committee was formed and presided over by

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[25] Ibid., p. 506; Mayne, 'Infantry Fire Tactics Suitable to the Canadian Militia', pp. 13-14; see also C. B. Mayne, The Late Battles in the Soudan and Modern Tactics: A Reply, (London: Gale & Polden, 1884), pp. 16-17.
[26] Mayne, Infantry Fire Tactics, p. 501.
[27] Ibid., p. 501.
[28] M. Samuels, Command or Control?: Command, Training and Tactics in the British and German Armies, 1888-1918, (London: Frank Cass, 1995), p. 49.
[29] Mayne, Infantry Fire Tactics, pp. 497-498.
[30] 'Précis of the Question of the Introduction of the Enfield-Martini Rifle, 1880-1886', p. 3, MOD Pattern Room Archive.

Lieutenant-General Campbell, the Director of Artillery and Stores.[31] This new body was neither sanguine about the magazine nor in favour of a bolt-action weapon. No doubt this was because of a desire to preserve existing command arrangements but it was also noted by the traditionalists that experience in war had proved that the Martini action to be both safe and reliable.[32] As far as the Duke of Cambridge was concerned there was insufficient evidence to show that the falling block action found in the Martini-Henry was redundant.[33]

Consequently, between 1880 and 1885, despite the protestations from other parties who wanted more investigations into magazine arms, the War Office spent the vast majority of its time and energy investigating an improved Martini action rifle. The weapon the Royal Small Arms Factory eventually came up with, known as the Enfield-Martini, utilised the same falling-block breech mechanism as the existing service rifle but had a smaller calibre of .402 inches compared to the Martini-Henry's .450". This was readily backed by the traditionalists who were looking to maintain the existing organisational arrangements within the Army.

However, as the arguments against the Martini action grew more engaging, the position adopted by the Duke of Cambridge on fire control became more robust. By November 1886 the Duke directed in a memorandum that, 'Independent firing in the attack formation should be discontinued altogether, and that in future volley-firing should be employed during all stages of the attack'.[34] The growing debate about magazine weapons clearly left the Commander-in-Chief believing it necessary to freeze problems associated with musketry fire at the point where an officer was necessary for the purposes of orchestrating, directing and commanding an infantry unit's shooting. In Cambridge's view the officer was absolutely necessary to the purposeful and successful performance of both the infantryman's activities and for

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[31] Ibid., p. 3.
[32] Ibid., p. 4.
[33] The Duke's preference was to have an improved weapon in the hands of the line infantry until another country developed a magazine arm at which point the British Army would then make the change. See Minute dated 19th November 1884, found in Ibid., p. 5.
[34] 'Trial of Magazine Rifles in Britain from 1879', p. 32, MOD Pattern Room Archive.

fruitfully and absolutely carrying out the instructions of the commanding general. Any weapon that might give the soldier more opportunity to use his initiative in the wasteful expenditure of ammunition had to be resisted. As far as Cambridge and the traditionalists were concerned magazine weapons might indeed have a role on the future battlefield but their pernicious tendencies needed to be limited.

The Royal Navy

Unlike the traditionalists, the Admiralty was considerably more enthusiastic about magazine rifles.[35] This was because the Royal Navy had a perceived need for weapons with higher rates of fire but were not bound by the same limiting factors facing the Army. Thus in October 1879 when the Lee Magazine Company presented a repeating rifle - which with some important modifications eventually became the LEME - to a naval committee on machine guns, the DNO embraced the opportunity to replace the Martini-Henry.[36] The traditionalists might have preferred to ignore the idea but given the constitutional place of the Navy, the DNO's interests could not be overlooked. The fact of the matter was that if the Admiralty proceeded to purchase a rifle independently of the Army then embarrassing questions might be asked about why the two services used different weapons. This in turn might lead to further questions about the relative costs of the two systems which would invite additional public scrutiny. At the same time, if the Admiralty wanted to secure access to cheaply manufactured, mass produced and high quality firearms then they had to work with the Army. This was because, since the reforms following the Crimean War, the Secretary of State for War was responsible for administering the Royal Small Arms Factory (RSAF),[37] an establishment which had recently been

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[35] See for example, ADM 116-349, National Archive (NA).

[36] Second Progress Report on Machine Guns, 1880, p. 7, 533 (200) AAA, MOD Pattern Room Archive.

[37] All of the factories were administered by the War Office's Supply Department after the government abolished the position of Master-General of Ordnance following the Crimean War. For more details with regards to the politics of this decision see J. Sweetman, War and Administration: The Significance of the Crimean War for the British Army, (Edinburgh: Scottish Academic Press, 1984).

refurnished with state-of-the-art machinery from the United States.[38] There were therefore compelling reasons as to why the two services had to cooperate over the development of small arms. This next section explores these reasons and explains why cooperation was so difficult to deliver.

In the absence of an inter-departmental organisation or staff responsible for co-ordinating appropriate activities, the Army and Navy possessed very few ways for developing agreement.[39] This was compounded by the fact that the official channel for correspondence between the two services was limited to the civilian posts of Under-Secretary of State for War and the Secretary to the Admiralty.[40] With both sides having little opportunity to develop a deeper understanding about their differing needs, the relationship invariably descended into a fight over the finite quantity of finance and resources.[41] This was a situation that was not helped by the way in which weapons were procured. The problem was that the Navy resented the way that the Army administered the Government Manufactories whilst the Army was not happy with the fact that the cost for storing naval ordnance was being charged to its Estimates.[42] This led to a multitude of problems where the Admiralty

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[38] Following Colt's demonstration of interchangeable parts at the Great Exhibition of 1851, a Royal Commission was sent to the United States to investigate US manufacturing techniques. This Committee recommended that the RSAF be re-equipped with machine tools from the United States. See McNeill, The Pursuit of Power: Technology, Armed Force and Society since A.D. 1000, pp. 233-235.

[39] Spiers, The Late Victorian Army, 1868-1902, p. 67.

[40] W. S. Hamer, The British Army; Civil-Military Relations, 1885-1905, (Oxford: Clarendon, 1970), p. 74.

[41] Both the Army and the Navy claimed primary responsibility for the defence of the home nation. As far as the senior service was concerned the fleet provided the principal means for protecting the British Isles. However, the proposed creation of a Channel tunnel in 1882 looked like it might upset their ability to retain this role. In the ensuing public furore about the state of invasion readiness, the War Office claimed that a coup de main through such a link would render naval defence redundant. This prompted the Government to reject the tunnel proposals but in the rumpus generated by the possibility of an attack by the French, the Admiralty took the opportunity to argue for more resources to ensure it could adequately defend the nation. Gladstone's Government was subsequently forced into spending an additional £5.5 million on ships, naval ordnance and coaling stations and the precedence of the Navy was assured. See Spiers, The Late Victorian Army, 1868-1902, pp. 224-226.

[42] See R. F. Mackay, Fisher of Kilverstone, (Oxford: Clarendon Press, 1973), p. 187.

would want to procure new equipment quickly whilst the War Office was content to delay.[43]

As the officer responsible for administering naval weapon purchases at the Admiralty, the DNO had to venture into this, less than auspicious, political environment for a number of purposes. Apart from the desire to make use of the facilities at the RSAF, the underlying rationale was that the Navy's small arms requirements could not be satisfied simply by accepting whatever the Army decided. Whereas the traditionalists wanted to maintain fire control and fire discipline, the Royal Navy, without the problem of transporting ammunition, was more interested in maximising the quantities of fire that could be generated. Throughout the age of sail one of the roles of embarked Royal Marines and sailors had been to repel boarders and engage sharp-shooters in the fighting tops of enemy ships. Engaging enemy shipboard infantry from a rolling ship required individual skill at arms and this meant that marksmanship, training and individual initiative took the place of volley fire, rigid drill and close order formations. At the same time quick reloading might make all the difference in close quarter fighting. Consequently, whilst a single-shot rifle would maintain the Navy's ability to defend its ships, what the Admiralty was really interested in was a weapon that might generate higher volumes of fire.

The Royal Navy's requirements did not end simply with the provision of a firearm appropriate for the Royal Marines. The reason for this was that during the 1880s the nature of the threat faced by the fleet evolved. The change was stimulated by a group of French naval theorists, known as the *jeune école*, who were keen to

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[43] For example, the Navy wanted to move to new breech-loading artillery so that they could take advantage of new advances in ammunition propellants. The Army, having been early adopters of an unsuccessful breech-loading mechanism, had moved back to muzzle-loading and were perfectly happy with their choice. As a result they saw no need to make quick changes to their own design of ordnance. For the background story on muzzle versus breech-loading artillery see Hamer, The British Army; Civil-Military Relations, 1885-1905, p. 44. For the story on why the Navy wanted to move to breech-loading artillery see McNeill, The Pursuit of Power: Technology, Armed Force and Society since A.D. 1000, p. 265.

resuscitate national pride following defeat by the Prussians in 1871.[44] A central plank in their approach to maritime strategy was the motor torpedo boat: a new class of vessel intended to cost effectively engage capital ships.[45] These fast moving craft were designed to dart in behind the slow traversing, muzzle-loading guns of the British fleet, thereby invalidating any advantages the Royal Navy might have possessed.

However, whilst the torpedo boat possessed a reasonable rate of speed, without adequate armoured protection the crew could be picked off by small arms fire.[46] Machine guns provided the most effective way of delivering high rates of fire against traversing targets and when placed on ships would not suffer the logistical penalties faced by the Army.[47] The trouble with these weapons was that they were notoriously unreliable. As the soldiers on campaign in the jungles and deserts of Africa repeatedly found out, getting the weapon to the battlefield was only half the problem. Of equal concern was how to keep it working.[48] Nevertheless, whilst the Army had difficulties, the Navy arguably had a better track record in this area. This reflected the fact that it kept its weapons on board ship where they could be protected from the elements and maintained by a crew that included the ship's

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[44] McNeill, The Pursuit of Power: Technology, Armed Force and Society since A.D. 1000, p. 263.
[45] Ibid., p. 263.
[46] D. K. Brown, Warrior to Dreadnought: Warship Development, 1860-1905, (London: Caxton, 2003), p. 117.
[47] Contrary to the argument made by Ellis the Army viewed these weapons very favourably. See Ellis, The Social History of the Machine Gun, p. 51. Bearing in mind the quantity of ammunition that these guns could use and their cumbersome weighty nature the Army believed the weapon was more appropriate in defence. For evidence of this see the following: the views of the Duke of Cambridge can be found in Machine Guns (Land Service) – Précis, 1867-1886, p. 6, 533 (200) AAA, MOD Pattern Room Archive; General Wolseley's views regarding the Gardner machine gun were influenced by the weapon's failures in North Africa, consequently he argued for more Nordenfelts. His views can also be found in Machine Guns (Land Service) – Précis, 1867-1886, p. 7, MOD Pattern Room Archive; see also Col. C. Brackenbury, 'The Latest Development of the Tactics of the Three Arms', JRUSI, Vol: 27, (1884), p. 482; General Roberts who was out in India was an advocate of the Gardner machine gun. His views can be found in B. Robson (ed.), Roberts in India - The Military Papers of Field Marshall Lord Roberts, 1873-1893, (Stroud: Alan Sutton Publishing, 1993), 'Remarks on Machine Guns', Madras 25th January 1885, note 210.
[48] Col H. Halford Bart, 'Lecture upon the New Service Magazine Rifle', Aldershot Military Society, (1888), pp. 3-4; and Ellis, The Social History of the Machine Gun, p. 82.

engineer.[49] Given the presence of these technicians, machine guns were consequently a lot more reliable when part of an onshore Naval Brigade. That did not mean that their weapons did not jam but it would be fair to say that the Navy had some notable successes when fighting alongside the Army. The most famous of these resulted in the award of a Victoria Cross to Captain Wilson at the Battle of El-Teb in 1884 during the First Sudan War.[50]

Bearing in mind the effort required to keep the machine gun operational, both services understood the need to either make it more reliable or find a more robust alternative.[51] And it was while the Navy was conducting further investigations into which machine gun that ought to be adopted for defending the fleet that the question of the magazine rifle first surfaced.[52] Magazine rifles represented an opportunity to have a more dependable weapon that could supplement the machine gun in times of emergency. Whilst a machine gun clearly provided the main method for suppressing torpedo boats there was no reason to assume that the magazine rifle might not perform the role in a complementary and more effective manner than the single-shot Martini-Henry. Consequently, despite the fact that the naval committee chaired by Captain P.H. Colomb RN was only meant to investigate machine guns, the members

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[49]This is certainly the view of Professor Andrew Lambert as stated in personal correspondence, Department of War Studies, King's College London, 9th October 2006.

[50] For more information about the involvement of Naval machine guns in land service see: 'Remarks on the Working of Machine Guns on shore by Naval Brigades', 533 (200) GARD, MOD Pattern Room Archive; a citation for Captain Wilson can be found at: http://www.victoriacross.org.uk/bbwilsoa.htm#top (website visited on 3rd November 2006).

[51] See for example: 'Reports Experiments between Nordenfelt and Hotchkiss Machine Guns, 1880', 533 (200) AAA; 'Report Experiments with Machine Guns at Shoeburyness, 1881', 533 (200) AAA; 'Gardner Machine Guns, 1876-1886', 533 (200) GARD; 'Machine Guns (Land Service) – Précis, 1867-1886', 533 (200) AAA; 'Remarks on the Working of Machine Guns on shore by Naval Brigades', 533 (200) GARD; 'Nordenfelt 1inch Machine Guns and Ammunition', 533 (200) – NORD. All of these documents can be found in the MOD Pattern Room Archive.

[52] The Navy had adopted .56in Gatling Guns in 1870. These were supplemented with Gardners which were introduced into service in 1884 following trials in 1880 and then Nordenfelts. These weapons were chambered in .45in although they could not use the same rolled brass cartridge as the Martini-Henry. When the Army adopted the Maxim and the LEME the Navy followed all using standard interchangeable .303" ammunition. This was the first time that ammunition was truly interchangeable between machine guns and rifles. See Brown, Warrior to Dreadnought: Warship Development, 1860-1905, p. 73 and 'Report Experiments with Machine Guns at Shoeburyness', p. 2.

agreed to extend their brief and started investigations into magazine rifles.[53] As a result they examined a further seven weapons including the M1874 Kropatchek magazine rifle recently adopted by the French Navy.[54] In October 1880, a new Chairman, Vice-Admiral Henry Boys, indicated that further experiments were, 'very desirable, and might lead to some advantageous results for both the Naval and Military Services'.[55]

The Admiralty took this message to heart and for the next two and a half years, whilst the traditionalists were prevaricating, continuously enquired how work on magazine arms was going. In February 1883, their persistence eventually led the War Office to create a Small Arms Committee on magazine rifles (referred to as the magazine rifle committee in what follows) subordinate to the main committee investigating the Enfield-Martini.[56] The move was, however, redundant for by then the Duke of Cambridge had committed the Army to an improved version of the existing rifle. Nevertheless what the Navy had managed to do was to keep the issue alive. This might not have resulted in an immediate change in War Office policy but when events in North Africa showed that the Martini was not reliable in difficult environmental conditions, the Navy had an opening to push for their preferred option. To make the case for change, however, the Adjutant-General, Sir Garnet Wolseley, would have to be persuaded.

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[53] When Captain Colomb was appointed to command HMS Thunderer in 1880, Vice-Admiral Henry Boys was appointed to replace him. See 'Machine Guns (Land Service) – Précis, 1867-1886', p.5.
[54] See 'Second Progress Report on Machine Guns, 1880', p.7, 533 (200) AAA, MOD Pattern Room Archive. The Committee also investigated two quick loading devices for the Martini-Henry. These items were intended to speed up the re-load time for the single-shot Martini. They still required the soldier to extract the round and therefore took longer to reload than any of the magazine arms. Eventually the idea of a quick loader was dropped in August 1885. See 'Special Committee on Small Arms – Report on Trials of Various Systems of Magazine arms, Quick Loaders etc.', 330 (200) AAA, MOD Pattern Room Archive.
[55] 'Second Progress Report on Machine Guns, 1880', p. 10.
[56] 'Précis of the Question of the Introduction of the Enfield-Martini Rifle, 1880-1886', p. 5.

The British Imperialists

Like the traditionalists the imperialists were concerned both with maintaining order on the battlefield and preserving ammunition. Where their views differed was in their attitude towards close order formations and rigid fire-control. The imperialists had seen what was possible whilst on campaign and in their opinion the official approach to tactics did not reflect the reality of combat. Confusion was a typical feature of an engagement as command and control broke down. Indeed, as units made their way to the objective, crossing difficult terrain or under fire, the commanding officer inevitably found it hard to keep his men under his direct control. As a result open order formation and independent fire was almost unavoidable. The question for the imperialists was how control might be maintained and military objectives achieved under such difficult circumstances.

All the same, this was but one component of the infantry battle. Of equal importance was that equipment should work in extreme conditions and at the end of long logistical chains. In this respect the imperialists not only believed that the traditionalists favoured inappropriate drill but that their devotion to the Martini-Henry was also misplaced. But as will be shown, whilst the Martini-Henry's disastrous performance in the desert during the First Sudan War of 1884-85 showed that there was reason to doubt the weapon's reliability, the imperial school did not necessarily advocate a magazine arm like the Royal Navy. Rather they took a pragmatic approach to technological change. If a sufficiently robust rifle became available then their tactical views left them open to new solutions in a way that the traditionalists were not.

The central figure in the imperialist group was the Adjutant-General, Sir Garnet Wolseley (from 1885, Lord Wolseley), who, with a wealth of military victories to his name, was known as 'our only general'.[57] The defeat of the French in the

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[57] H. Kochanski, Sir Garnet Wolseley: Victorian Hero, (London: Hambledon Press, 1999), p. xiii; Wolseley was Adjutant-General from 1st April 1882 to 1st October 1890. He then became Commander of the Army in Ireland before replacing the Duke of Cambridge and being made Commander-in-Chief in 1895. He was in command during the Red River Expedition of 1870, the

Franco-Prussian War of 1870-71 led Wolseley and his entourage, like many others, to express an interest in the Prussian mode of military organisation.[58] However, his experience of colonial warfare led him to take an increasingly critical view of the European approach. Rather than accept continental thinking wholesale, Wolseley and the imperialists were happy to select those methods that they believed most appropriate to their needs and adapt them to the British context.[59] The main reason for this was that as far as they were concerned, the Army's primary purpose was home defence and imperial policing.[60]

Understandably then, the imperialist school was a great believer in the Cardwell reforms. This was because short service enabled the Army to create a reserve force ready for a national emergency such as an invasion whilst linked battalions made it easier to rotate units between home and imperial defence. What the system could not cope with, given the unwillingness of successive governments to finance it properly, were the needs generated by active campaigning. As a result, in 1882 the Secretary of State was forced to call out the First Class Army Reserve to enable Wolseley to scrape together a sufficient force appropriate for war in Egypt.[61]

Battling with the War Office and the government in an attempt to create a sufficiently well organised Army ready for home defence and colonial campaigning was only the start of the challenges faced by the imperialists. Some of the most difficult problems for Wolseley and his favoured acolytes, known by some as the 'mutual admiration society', occurred when actually on campaign.[62] Colonial warfare provided Wolseley with an abundance of experience commanding British forces in defence of the Empire but it was not always, as some critics noted, the

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Ashanti Campaign of 1873-74, the Sekhukhuni Campaign of 1879, the Egyptian War of 1882 as well as the failed First Sudan War of 1884-85.

[58] Bailes, 'Patterns of Thought in the Late Victorian Army', p. 37.

[59] Ibid., p. 38.

[60] Ibid., p. 38. Unfortunately for the imperialists, however, they could not enshrine these priorities in government policy until the Stanhope memorandum of 1888.

[61] M. J. Williams, 'The Egyptian Campaign of 1882', in Victorian Military Campaigns, B. Bond (ed.), (London: Hutchinson & Co, 1967), p. 250.

[62] I. F. W. Beckett, 'Wolseley and the Ring', Soldiers and the Queen, Vol: 69, (1992), p. 14.

enemy that caused him the most trouble.[63] In fact the biggest difficulty came from fighting in demanding geographical conditions at the end of a long supply chain that originated in Woolwich Docks.[64] As the 1870 Red River expedition to Canada proved, the greatest effort for Wolseley often came from portaging his men, equipment and supplies from one location to another only to find that his adversaries had long since departed.[65]

Consequently, given the exertions required to engage with the enemy it could prove disastrous if equipment did not work and improvisation proved impracticable. And in this respect there can be little doubt that Wolseley's interest in small arms was stimulated by his failure to relieve Gordon in the First Sudan War of 1884-85. For whereas the traditionalists generally felt that the Martini-Henry had performed well in battle – in 1879 at Rorke's Drift for example - its reputation was being severely tarnished by Wolseley in his dispatches from North Africa. It could be argued that this was part of an attempt to obscure questions about his own failings as a commander.[66] However, the fact remained that the Martini-Henry did not appear to work very well in the desert. Under Parliamentary and public pressure generated by Wolseley's reports, W.H. Smith, the then Secretary of State for War, was forced into establishing in 1886 a Royal Commission to investigate the matter.[67] Sir James Stephen, the Commission's chairman, was directed to examine the system for adopting patterns of warlike stores, find who or what was responsible for the

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[63] A. Preston, 'Wolseley, the Khartoum Relief Expedition and the Defence of India, 1885-1900', Journal of Imperial and Commonwealth History, Vol: 6, (1980), p. 262.
[64] Beckett, 'Wolseley and the Ring', p. 21; H. Bailes, 'Technology and Imperialism: a case study of the Victorian Army in Africa', Victorian Studies, Vol: 24, (1980).
[65] In the case of the Red River expedition, Wolseley advanced from Lake Superior to Fort Gary on Lake Winnipeg only to find that the rebellious French-Canadians had abandoned their positions in order to flee to the United States. See Kochanski, Sir Garnet Wolseley: Victorian Hero, pp. 44-51.
[66] Preston, 'Wolseley, the Khartoum Relief Expedition and the Defence of India, 1885-1900', pp. 263-264.
[67] Martini-Henry Rifles – Questions as to Jamming of Cartridges, and of Solid v Rolled Cases, March 1885, p. 8. Questions were also being raised in the house about rolled versus drawn cartridge cases, for example see, Parliamentary Debates Vol. 308, 5th Aug to 9th Sept 1886, col. 1746.

equipment failures and make recommendations about how to improve procurement practices.[68]

Irrespective of the public pronouncements made in the Stephen Report, what the War Office's own internal investigations found was that the Martini style breech action was not as reliable as the traditionalists asserted especially when used in conjunction with Mark III or Mark IV ammunition.[69] This was because the rolled brass bottlenecked cartridge developed for the Martini-Henry was a particularly weak design originally recommended by the Fletcher Committee in 1871. The case was made from a coil of thin brass wrapped in such a way as to create a cartridge that was then fixed to a disc that formed a rimmed priming cap. By contrast a fully drawn cartridge was more reliable but heavier and considerably more expensive to manufacture given the need for specialised machine tools to hammer or draw out the case. Unfortunately, when several rounds had been fired, the chamber of the Martini-Henry became very hot and this had the effect of weakening an already fragile ammunition case in such a way as to make it likely that the cartridge would jam in the breech. At this point either the extractor would be unable to remove the spent round or it would rip off the priming cap leaving the coiled case in the firing chamber. Needless to say in combination with extremely hot and dusty conditions on campaign in Africa the weapon was extremely prone to failure, usually at the most inconvenient time.[70]

But whilst the report substantiated the claims made by Wolseley about the disastrous performance of the Martini-Henry in the desert, it was still possible for the

[68] Report of the Royal Commission appointed to inquire in the System under which Patterns of warlike Stores are adopted and the Stores obtained and passed for Her Majesty's Service, C. 5062 (1887), p.1 (hereafter known as the Stephen Report).

[69] See 'Martini-Henry Rifles – Questions as to Jamming of Cartridges, and of Solid v Rolled Cases'.

[70] Although the problems with the round had been recognised since as early as 1881 no remedial action had been taken to resolve the issue because discussions had already started about introducing the Enfield-Martini. Accordingly, the Duke of Cambridge and Hugh Childers, the then Secretary of State for War agreed not to make the needed modifications, on grounds of cost. Following an investigation into the reliability of the coiled cartridge case in March 1885, fully drawn cartridges were finally approved by the Secretary of State, Lord Hartington and were sent out to General Wolseley too late to make any difference in the Sudan. See 'Martini-Henry Rifles – Questions as to Jamming of Cartridges, and of Solid v Rolled Cases'.

traditionalists to blame the coiled ammunition rather than the weapon's breech-action. So when Cambridge was looking at replacing the Martini-Henry with the Enfield-Martini, Wolseley was not at first opposed.[71] However, as it became clear that the Enfield-Martini might suffer the same problems as the weapon it was to replace Wolseley became more open to the possibility of a different breech action.[72] This did not mean that he advocated a magazine arm. Just like the machine guns that had so regularly failed at critical times on the battlefield such weapons might suffer even worse technical failings. Rather, his willingness to look at different technical solutions to the breech-loading problem was rooted in his tactical outlook. For unlike the traditionalists, the Adjutant-General was not wedded to close order formations and volley firing. As a result he could accept another form of rifle so long as it was sufficiently robust and did not compromise his views of combat. As far as Wolseley was concerned, 'the great object of all military teaching is to develop the power of each breech-loading rifle, and the independent action of the soldier who carries it, to the fullest possible extent'.[73]

Essential to a programme focused on developing the power of each man and his rifle was the need to recognise that chaos in combat was the norm. Indeed, contrary to the ideas of C.B. Mayne, Wolseley affirmed that he had, '...never seen an instance of any position being assaulted in which companies and battalions were not mixed in a very curious way...'.[74] In real battle units always became inter-mingled making tactical control by officers extremely hard. Confusion was further compounded by the nature of the formations infantry had to take either as a result of enemy fire or because of the terrain being crossed.[75]

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[71] 'Précis of the Question of the Introduction of the Enfield-Martini Rifle, 1880-1886', p. 21.
[72] Ibid., p. 24.
[73] G. J. Wolseley, The Soldier's Pocket-Book for Field Service, 4th edn., (London: Macmillan, 1882), p. 366.
[74] For more of Wolseley's views see Brackenbury, 'The Latest Development of the Tactics of the Three Arms', pp. 480-481.
[75] Ibid., p. 480.

To Wolseley the evidence in support of open order tactics was therefore compelling. This is because it reflected both the reality of the empty battlefield: where the enemy had taken cover so that they could not be seen and troop dispersal increased survival chances; and the difficulty of manoeuvring units over broken ground.[76] In these circumstances, the traditionalist's approach to fire control was impossible. Open order formations effectively meant that the troops would be too distant to hear or to be in control of their commanding officer.[77] Accordingly volley-fire would be next to unattainable either on the attack or at close range.[78] And this meant that individual skill at arms would be the most important factor in battle. Infantrymen would have to use their initiative and pick out their own targets whilst avoiding the unnecessary wastage of ammunition.

However, if open order tactics and the use of individual fire were to become the norm then prior training had to coach the men properly so that they understood what conditions they would be expected to fight in. The key to realising this goal was through the effective use of drill based on actual battlefield conditions. Wolseley's approach was not that of the traditionalist who insisted on the parade ground manoeuvres so beloved of Cambridge.[79] Rather it was intended to allow an officer to, '...get at the enemy with as little loss as possible, and as quickly as it is possible to do so'.[80] To establish what drills ought to be taught, Wolseley believed that it was essential to study the way actual battles were fought, '...accept certain difficulties; work back from those..., and try to take the sting out of the disorder which we know to be inevitable... deduce laws from it, and formulate your drill to suit them'.[81]

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[76] Ibid., p. 480; P. Griffith, Forward Into Battle: Fighting Tactics from Waterloo to the Near Future, revised and updated, (Novato, CA: Presidio, 1991), p. 50-94.
[77] Brackenbury, 'The Latest Development of the Tactics of the Three Arms', p. 482.
[78] As stated by Colonel Maurice in his Encyclopaedia Britanica article "War" as referenced in C. G. Slade, 'Modern Military Rifles and Fire Tactics', Vol: 32, (1888/1889), pp. 914-915.
[79] B. Bond, 'The Retirement of the Duke of Cambridge', Vol: 106, (1961), p. 544.
[80] Col. C. Brackenbury, 'The Latest Development of the Tactics of the Three Arms', Vol: 27, (1884), pp. 479-480.
[81] Ibid., p. 480. The importance of Wolseley's views can be seen in the RUSI Journal which was running a Military Prize Essay competition on '"Discipline", its importance to an armed force and the best means of promoting and maintaining it', see JRUSI 1889/1890, Vol. 33, No. 148.

Because of his relative position to that of the Commander-in-Chief, Wolseley did not have the wherewithal to implement his views without the exertion of considerable effort. Nonetheless, that did not stop him from developing his ideas with the help of others. Two officers in particular stand out for their contributions. The first was Colonel John Frederick Maurice, who spoke about drill on several occasions and was appointed, by Wolseley, to the Staff College as Professor of the Military Art and History in 1885.[82] The second was Lieutenant-Colonel (later Brigadier-General) MacDonald, a Volunteer, and Scotland's Lord Advocate who first lectured on the same issue in 1885 to the Royal United Services Institute and was to do so again, this time chaired by Wolseley himself in 1890.[83] All three men were on good terms, regularly attended each other's lectures and believed that the substantive lesson of the Franco-Prussian War of 1870-71 was that, '...whereas under the old condition of fighting the General in command had to handle a machine, now he has to lead and guide a body which has become infused with a mind and spirit of its own'.[84]

The theme running through MacDonald and Maurice's lectures was related to freeing the infantry from 'cumbrous and roundabout movement' in order to avoid unnecessary fatigue by approaching the enemy directly. If close order formation meant troops were locked up, shoulder to shoulder, then the objective of these new drills was to develop, '...an accuracy of movement without touch over the fire-swept

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[82] J. Luvaas, The Education of an Army: British Military Thought, 1815-1940, (London: Cassell, 1964), pp. 192; for example see, Col J. F. Maurice, 'The Advantages of a Simple Drill Nomenclature Consistent for all Arms, "appropos" to an Incident of the Battle of Tel-el-Kebir', JRUSI, Vol: 32, (1888/1889).

[83] Lt-Col J. H. A MacDonald, 'The Changes Required in the Field Exercise for Infantry', JRUSI, Vol: 29, (1885/1886), p.147; Brig Gen J.H.A. Macdonald, 'Infantry Training', JRUSI, Vol: 34, (1890), p. 649. MacDonald had been writing about the inadequacies of parade ground drill for thirty years. His views were expressed in pamphlets and lectures such as 'On the Best Detail Formation for the New Infantry Tactics' (1873) and 'Commonsense on Parade, or Drill without Strings' (1886). MacDonald's views on forming fours was adopted in 1893, 'touch' was abolished in 1896 and keeping the front rank to the front at all times was abandoned in 1902 following MacDonald's cooperation with GFR Henderson who was working on the new Infantry Drill Book, see I. F. W. Beckett, Rifleman Form: A Study of the Rifle Volunteer Movement, 1859-1908, (Aldershot: 1982), p. 203.

[84] Brackenbury, 'The Latest Development of the Tactics of the Three Arms', p. 461. See also Luvaas, The Education of an Army: British Military Thought, 1815-1940, p. 178.

zone, both as regards [to] interval and direction, that the chances of producing a solid, well put together organism for the deciding blow, for the shock of the charge, [will] depend'.[85] And in this respect the imperialists remained true to their experience of battle which demonstrated that the infantry would actually still need to get up close to the enemy, push them off their ground and occupy their positions, sometimes at the point of the bayonet.[86]

The organisational means by which MacDonald thought this possible was through a system of grouping soldiers together.[87] This was not a replacement for the existing organisational structures, i.e. by Section, Platoon, Company, Battalion etc., but rather a way of combining troops into what today some armed forces might call a 'buddy' system.[88] The usual mode of organising the soldier in the Victorian Army was on the basis of what duties they might be expected to perform in the barracks rather than whether they were friends who could rely on each other in battle. Thus, one senior officer stated, 'We always comrade the men the initials of who are in the first half of the alphabet, with those whose initials in the second half... We do this so that both of them may not be detailed for duties at the same time'.[89] By contrast, MacDonald's ambition was to group comrades together so that they were administered and trained by one set of officers and NCOs rather than being passed around the battalion as dictated by training and garrison duties. To MacDonald such a grouping would encourage soldiers to develop, maintain and retain their cohesion such that when they became intermingled on the battlefield they would more easily be able to re-form and put themselves at the command of their commanding officer.[90]

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[85] MacDonald, 'The Changes Required in the Field Exercise for Infantry', p. 146.
[86] Wolseley had famously defeated the Egyptians at Tel-el-Kabir in 1882 precisely by launching an early morning bayonet charge on enemy positions, see Williams, 'The Egyptian Campaign of 1882'.
[87] For Maurice's views see Macdonald, 'Infantry Training', p. 637.
[88] For example see 'Infantry Squad Tactics', Marine Corps Gazette, November 5th 2005 found at http://www.military.com/forums/0,15240,79595,00.html, website visited on 23rd June 2006.
[89] Macdonald, 'Infantry Training', p. 623.
[90] Ibid., p. 624-625.

To old hands, however, such a change might undermine the command structure MacDonald was trying to improve. As far as some regimental authorities were concerned, one reason why the barracks were organised with garrison duties in mind was in order to keep the men from getting bored and resorting to drink and prostitutes.[91] At the same time, encouraging too much familiarity between officers and ranks could also breed contempt. Consequently, NCOs and officers were encouraged to keep distinct messes and ways of working so that they might more easily be able to sustain the formal hierarchy of command.[92]

Nevertheless, the evidence as far as Maurice, MacDonald and Wolseley were concerned was clear. Chaos and the intermingling of units was the battlefield norm. Open order tactics were essential to avoid unnecessary casualties and fire control was harder to orchestrate by word of command. Troops would have to become adept skirmishers if they were to operate effectively in the empty battlefield. Discipline was of course a very necessary feature of Army life but it was in the area of drill that a resolution to the various tactical problems could be found. The objective was to find a way to achieve, '...the preservation of order in disorder, and of system in confusion...'.[93] If this was to be successful then it was essential that training should reflect and prepare troops for what they were paid to do: fight.

Wolseley's views on tactics were primarily concerned with fostering greater individual responsibility in the use of a soldier's personal weapon. Accordingly, he was neither a supporter of excessive fire-control nor of the over-use of drawing ammunition from the magazine. Instead Wolseley advocated an approach to training that showed soldiers how to use their weapons based on their own initiative and logistical prudence. When it came to developing a weapon to replace the Martini-Henry, Wolseley still needed to be persuaded by others that the magazine arm was a

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[91] French, Military Identities: the Regimental System, the British Army, and the British People, c.1870-2000, p. 109.
[92] Ibid., pp. 124-128.
[93] References the experience of a veteran of the Light Brigade quoted by G.F. R. Henderson, (1890), 'The Training of Infantry for the Attack', p. 351, first published in the RUSI Journal in 1890, found in Col G. F. R. Henderson, The Science of War, (London: Longmans, 1910), pp. 338-364.

viable alternative. The First Sudan War had convinced him that a change from the falling block breech action might be worthwhile but it did not follow that he had to accept the introduction of a magazine as well. This was because colonial campaigning had shown the imperialists how difficult it was to sustain an army in the field, thousands of miles from the Woolwich docks. Complicating this by increasing the volumes of ammunition a soldier could fire might not necessarily aid a general in his attempts to achieve victory. At the same time if troops could be trained to use the reserve of cartridges in the magazine only when absolutely necessary then the logistical and command and control implications of the weapon could be minimised. Nonetheless, there were at least two issues that needed to be resolved if Wolseley was to be brought around to the idea. These related to whether such a weapon could be both reliable and logistically viable when used at the ends of a long supply chain.

The Radicals

Unlike the imperialists and the traditionalists, the radicals were the only members of the Army both in favour of increasing the quantity of firepower troops could generate and unafraid of the logistical implications that such an attitude implied. Where the radicals and imperialists were in alignment was in relation to their views on open order tactics and effective combat training. However, if the radicals were to convince Wolseley and others that the next weapon should include a magazine then reliability and the question of the strain on the supply chain would have to be addressed. At the same time, contrary to the traditionalists who saw this as the thin end of the wedge, these progressives did not argue that this new technology would necessarily entail disruptive challenges to officer-man relations across the whole of the Army. Instead, they preferred to downplay the organisational implications of the LEME and focused their attention on how the magazine rifle would improve the ability of the light infantry to fire at a rate comparable with the regiments of the line. That is not to say that the radicals were not great advocates for their particular style of warfare; they were just more politically astute about how to make a case for change than some might have given them credit for.

The main protagonist in the story of the LEME who took a radical perspective on firepower and logistics was Lieutenant-Colonel Slade, Commanding Officer of the 2nd Battalion the Rifle Brigade. Slade's prominence was guaranteed following his appointment to the committee on magazine arms, created at the persistence of the Royal Navy in February 1883. Coming from a regiment with a tradition of light infantry tactics made famous by the Peninsular War, Slade was well groomed in the virtues of the rifle. Traditionally, rifle regiments were employed as skirmishers, fighting in open order and using a rifle rather than a musket to pick off targets at range. When compared to smooth bore muskets, the muzzle loading rifle was difficult to reload quickly. The development of breech-loading technology and the boxer, self-contained cartridge were therefore extremely welcome to riflemen because taken together both inventions increased the speed at which a rifle could be fired. But welcome as they were, the weapon still needed to be re-loaded by hand and this meant that rifle regiments strung out in open order were unable to concentrate their fire in the same way as their close order, volley firing, heavy infantry colleagues.

Nevertheless, it was not the rifle of and by itself that was important to these skirmishers but their approach to marksmanship, training and their progressive attitude towards discipline that created the right conditions upon which success on the battlefield could be achieved.[94] The weapon may have been the physical representation of the rifle regiments' philosophy but whilst respected, it was a philosophy that caused a degree of wariness in the rest of the Army. This was partly because many in the rifle regiments believed that the effectiveness of their weapon was determined by training light infantrymen to use their initiative rather than simply to obey orders in a parade ground fashion. With the Army famously described by the Duke of Wellington as being 'composed of the scum of the earth' such a novel approach did not sit well with those regiments that preferred to instil a

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[94] R. Holmes, Redcoat: the British Soldier in the Age of Horse and Musket, (London: HarperCollins, 2002), pp. 43-44; J. F. C. Fuller, Sir John Moore's System of Training, (London: Hutchinson & Co, 1925), pp. 221-222.

more formal system of discipline and drill.[95] One of the most obvious areas where this manifested itself was in relation to corporal punishment. For whilst the light infantry had avoided making excessive use of flogging since Sir John Moore's time 100 years previously, the rest of the Army only abolished it in 1881.[96] Thus, in many respects Slade's appointment to the committee on magazine rifles was likely to cause a clash with those more conservative members who were wedded to more formal and traditional modes of military organisation.

That Slade was fighting an uphill battle with his more conservative-minded colleagues is demonstrated by the fact that on a number of occasions he was compelled to append his minority views to the recommendations of the full committee.[97] The reason for this was that on the most important matters relating to fire control, logistics and reliability, Slade took a more radical position than that expressed by the rest of the committee. By contrast, the majority consistently argued for weapons that were least likely to upset the decision that had already been taken to procure the Enfield-Martini. Accordingly they were happy to recommend a magazine arm only if could be shown to possess, '...advantages over a single loader' whilst having no '...disadvantages peculiar...' to it.[98] Having examined 31 different firearms the committee was, therefore, only prepared to put forward three rifles for further consideration as a magazine arm.[99] The first was the Owen Jones which used the same breech action as the Enfield-Martini. The other two were bolt-action weapons based on the design submitted by the Lee-Magazine Company to the naval committee on machine guns in 1879. However, despite this apparent willingness to

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[95] J. F. C. Fuller, British Light Infantry in the Eighteenth Century (An Introduction to "Sir John Moore's System of Training"), (London: Hutchinson & Co, 1925), p. 232. There are comparisons here with the social-technical changes occurring in the mid-19th century French Army. See P. Griffith, Forward into battle : fighting tactics from Waterloo to the near future, Rev. and updated ed, (Novato, CA: Presidio, 1991), pp. 59-67. For contemporaneous commentary on the issue see A. Du Picq, Battle Studies, (New York: Macmillan Co., 1921), pp. 250-253.
[96] Hansard, HC (series 3), vol. 49, col. 212.
[97] 'Reports on Trials of Various Systems of Magazine Arms, Quick Loaders etc, 1885', p. 9.
[98] Ibid., p. 6.
[99] For a full list see, 'Trial of Magazine Rifles in England from 1879 & A Memo by Colonel Slade on the General Question of Magazine Rifles, 1887', pp. 6-9, MOD Pattern Room Archive.

recommend a magazine arm for future service, they did so without any conviction as to the utility of the technology.[100]

This can be demonstrated in a number of ways. Take for example the issue of reliability. As far as the magazine rifle committee was concerned the most reliable breech closing mechanism available was the falling-block found in the Martini-Henry and reproduced in the Enfield-Martini.[101] This system had the backing of the Duke of Cambridge and, the problems of the First Sudan War aside, was believed to be the most reliable system available.[102] The 1871 Fletcher Committee had thoroughly examined all the alternatives, including the bolt-action, before recommending the Martini-Henry and little evidence existed to show that this advice was no longer relevant.[103] The North African experience had not invalidated this conclusion. The War Office's own internal investigation had shown that the ammunition was to blame for the weapon's failures: there was no inherent weakness in the Martini-Henry's design.[104] The Lee Magazine Company's firearm, by comparison, used a bolt system which, despite having proved itself over a number of trials, the committee was happy to test further but reluctant to state was appropriate for service.[105] Instead they preferred the Owen Jones, a weapon that utilised a falling-block breech mechanism.

Whilst Slade did not criticise the Owen Jones directly it is clear that he saw some very serious flaws in the proposal which, bearing in mind his repeated warnings, the committee was thoroughly versed in. The first was that members had made the

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[100] Ibid., p. 11.
[101] As demonstrated in the early reports from the magazine rifle committee, see Ibid., p. 3.
[102] The Duke's preference was to have an improved weapon in the hands of the line infantry until another country developed a magazine arm at which point the British Army would then make the change. See Minute dated 19th November 1884, found in 'Précis of the Question of the Introduction of the Enfield-Martini Rifle, 1880-1886', p. 5.
[103] For reports of the Fletcher Committee see, 'Trials of Breech-Loading Small Arms, 1864-1867' and 'Reports of Special Committee on Martini-Henry Breech-Loading Rifles, 1871', both in the MOD Pattern Room Archive.
[104] See, 'Martini-Henry Rifles – Questions as to Jamming of Cartridges, and of Solid v Rolled Cases'.
[105] See, 'Reports on Trials of Various Systems of Magazine Arms, Quick Loaders etc, 1885'.

recommendation after examining only one example of the weapon.[106] Accordingly, the committee had no way of establishing the design's reliability in relation to a number of rifles. The second and more serious concern was that according to Slade, 'The falling block of the Martini breech-action has... baffled every inventor who has attempted to adapt a magazine attachment to it'.[107] As a result he believed that it was almost a 'mechanical impossibility' to modify this type of breech mechanism for use with a magazine.[108] The effort involved in making such a device work would result in a fragile mechanism that was unlikely to survive in the field once it had got into the hands of the soldiery and away from the careful nursing provided by engineering staff. As far as Slade was concerned if the War Office went ahead with the Enfield-Martini it would be out of the question to convert it into a magazine rifle.[109] To go down the road of adopting a falling-block breech would either lock the Army into a single-shot weapon for some years to come, or involve the War Office in even greater time delays and costs as they sought to change to a more robust magazine arm at a later date.[110]

But reliability was not the only issue about which Slade was prepared to argue over. When it came to logistics the committee took the view that a magazine arm would not place undue stress on the supply chain. This was because they questioned the idea that a magazine, of and by itself, would produce a firepower revolution on the battlefield. Experiments conducted on behalf of the committee had shown that, over the course of a minute, the number of rounds that could be fired from a rifle with a magazine was not greater than the quantity that a single-shot Martini could produce in the same time.[111] This reflected the fact that no recharging devices were available for any of the weapons under examination and thus each round had to be reloaded one at a time once the magazine was empty. That was not to say that the committee

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106 'Trial of Magazine Rifles in England, 1879', p. 15.
107 Ibid., p. 31.
108 Ibid., p. 31.
109 'Reports on Trials of Various Systems of Magazine Arms, Quick Loaders etc, 1885', p. 9.
110 Ibid., p. 9.
111 See Tables comparing the rapidity of fire, with and without aim, of the three Magazine Rifles and the Martini-Henry Rifle in Ibid., Appendix C, pp. 114-118.

did not believe that a magazine arm might not be important at a critical moment when a very high volume of fire was required or, for that matter, that troops might not feel a boost in morale when armed with such a device. Such benefits were nonetheless, dependent on both the size of the magazine (magazines examined by the committee contained between five and eight rounds) and the speed at which it could be reloaded. A consequence of this, according to the committee sceptics, was that contrary to the opinions of many officers, soldiers would not need to carry more ammunition because they would be unable to fire it all at the crucial point.[112]

That said, the supply chain would only remain unaffected by a magazine attachment if the War Office accepted the specific suggestions of the committee. In particular this meant that troops ought not to be allowed the opportunity to replace a detachable empty magazine, which they might lose, with a fresh one. Thus as far as the majority of the members were concerned, a magazine ought to be either non-detachable, fixed or integral to the rifle. Accordingly, they favoured the Owen Jones which, despite its fragility, had a fixed magazine and recommended that the two rifles based on the Lee design be altered likewise. The first of these, known as the Improved Lee had the detachable magazine from the 1879 version screwed to the receiver preventing it from being removed. The second, known as the Lee-Burton, utilised a fixed magazine to the side of the receiver in a similar fashion to the Owen Jones.[113] The result of these modifications was that the soldier was forced to reload the weapon one round at a time from his ammunition pouch thereby slowing down their ability to fire all their ammunition at once. Fixing the magazine to the rifle was, therefore, a technical solution to the problem of enforcing fire control, demonstrating just how little the rank and file was trusted.

By contrast Slade was a strong proponent of detachable magazines.[114] This was because the device would allow the men to fire all their ammunition and then re-load quickly by replacing the spent one with a fresh magazine. As a result troops would

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[112] Ibid., p. 6.
[113] Ibid., p. 7.
[114] 'Trial of Magazine Rifles in England, 1879', p. 25 and p. 33.

have more flexibility to use their weapon as the battle dictated. However, whilst this might increase the quantity of firepower generated, it also posed considerable challenges for those managing the supply chain. Unfortunately for Slade, if the War Office persisted in its decision to adopt .402" Enfield-Martini calibre ammunition then his suggestions would be difficult to implement. This was because the .402" round was too large and would necessitate a clumsy magazine.[115] On the other hand if a smaller alternative might be found then the magazine might become handier. At the same time more rounds could be carried in the baggage train for the same weight as the larger ammunition which in turn alleviated the logistical implications posed by an increase in firepower.

Similar views had been aired by Lieutenant-Colonel Fraser of the Royal Engineers during the summer of 1884. At that time he had stated that smaller bore ammunition would be more appropriate for short service recruits.[116] In his view a .38" or .39" calibre round with a cartridge case containing a propellant that produced high muzzle velocities would result in a rifle that could 'shoot by itself'.[117] A weapon that created minimal recoil would be easier to learn how to use because it would not be so uncomfortable to fire. At the same time a round with a flatter trajectory helped soldiers to hit their targets by minimising 'personal errors of aiming'.[118] Fraser's suggestions had been rejected by Wolseley and Cambridge on the basis that considerable effort had already been put into developing .402" ammunition.[119] Nonetheless, Slade seized on the possibility stating that, 'The Service arm of the future will be a small bore, having a magazine or feeding apparatus of some sort…'.[120] The question was could a technical solution be found that might realise Slade's ambitions?

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[115] Memo by Colonel Slade, August 1885, see Ibid., p. 32.
[116] Lt-Col Fraser was president of the Special Committee examining Siege Operations. See, 'Précis of the Question of the Introduction of the Enfield-Martini Rifle, 1880-1886', p. 7.
[117] Lt-Col Fraser was president of the Special Committee examining Siege Operations. See Ibid., p. 7.
[118] Ibid., p. 7.
[119] Ibid., p. 8.
[120] Memo by Colonel Slade, August 1885, see 'Trial of Magazine Rifles in England, 1879', p. 11.

In 1885, in the absence of a viable smaller calibre round, Slade's views were making little impact with either his committee colleagues or with Cambridge and Wolseley. As far as the War Office was concerned, the Enfield-Martini would replace the Martini-Henry.[121] However, with the publication of the magazine committee's final report in August the Navy jumped at the chance to undertake large scale trials of the Owen Jones.[122] Accordingly the Admiralty pressed for 2000 weapons to be made so as to establish their viability.[123] Unfortunately for the DNO just at the moment he began to think it might be in a position to adopt a magazine rifle the Superintendent of the RSAF voiced some concerns about manufacturing it.[124] No doubt aware of the complexities in making a Martini-action with a magazine, the suggestion was made that 100 Lee-Burton weapons ought to be trialled alongside the Owen Jones thereby making it possible to compare the two weapons.[125] What followed was a battle of wills between the Superintendent of the RSAF who preferred the Lee-Burton and the Admiralty who wanted to carry on experiments with the Owen Jones. In the end an agreement was reached whereby 2000 Owen Jones were made for the Navy, and 150 Lee-Burtons and 150 Owen Jones were made for the Army.[126]

The summer of 1886 was consequently an important time for both the Admiralty and the War Office as both services sought to establish which of their preferred weapons would prove appropriate for adoption. The Navy was testing the Owen Jones whilst the Army was still trialling the Enfield-Martini as well as the Improved Lee and Lee-Burton. By December the Navy had not only discounted the Owen Jones, most probably because of the complexity of the falling breech-block and magazine attachment, but positively embraced the Lee bolt-action.[127] At the same time with questions still circling in relation to the design of the Enfield-Martini the Adjutant-

[121] 'Précis of the Question of the Introduction of the Enfield-Martini Rifle, 1880-1886', p. 24.
[122] 'Trial of Magazine Rifles in England, 1879', pp. 12-17.
[123] 'The Magazine Rifle', p. 8, ADM 116-349, NA.
[124] 'Trial of Magazine Rifles in England, 1879', p. 12.
[125] Ibid., p. 12.
[126] Ibid., p. 16.
[127] 'The Magazine Rifle', p. 9, ADM 116-349, NA.

General signalled a renewed interest in magazine arms.[128] And this prompted Lieutenant-Colonel Slade to revitalise his efforts in relation to the Lee bolt-action. This time, however, he could count on the support of the Admiralty.

Bearing in mind that the radicals and imperialists had a shared outlook on certain problems of battle, Slade's starting place in his efforts to persuade the sceptics as to the virtues of the Lee magazine rifle was Lord Wolseley. During the winter of 1886-87, Slade produced a long memorandum on magazine arms which he submitted to the Adjutant-General for consideration.[129] In it, he stated that he believed the weapon of the future would be,

> ...a small bore, probably .300, the bullet steel-cased, and the charge compressed powder, or a smokeless chemical compound. The soldier will carry on his person from 120 to 150 rounds, the magazine will be detachable, and the soldier will carry two or three, ready loaded, each holding from 10 to 15 cartridges.[130]

Given the trials conducted by the magazine rifle committee, the continued suspicions about the falling-block breech mechanism and the renewed interest of the Royal Navy, Slade argued that the Improved Lee's bolt-action mechanism offered a level of reliability other systems could not.[131] This was a point that Wolseley appeared to concede when he decided to reopen the question of magazine arms. But if the question of reliability could be addressed then the matter that would make or break Slade's argument was related to the tactical implications posed by such weapons.

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[128] Wolseley voiced concerns about the Enfield-Martini trials in April 1886, see 'Précis of the Question of the Introduction of the Enfield-Martini Rifle, 1880-1886', p. 24; and then by November of that year was asking the magazine rifle committee to undertake further trials see, 'Trial of Magazine Rifles in England, 1879', p. 19.
[129] See memo found in 'Trial of Magazine Rifles in England, 1879', pp. 28-33.
[130] Ibid., p. 33.
[131] Ibid., p. 24.

Slade understood this perfectly well.[132] However, in his attempts to convince Wolseley he chose to downplay the tactical concerns by arguing that fire-discipline would remain of paramount importance.[133] Fire discipline held the key to ammunition wastage. If discipline could be maintained then Wolseley's logistical concerns would be alleviated. At the same time, according to Slade, choosing a magazine arm of and by itself had nothing to do with the weapon's inherent superiority but was important in order, '...to keep abreast of one's neighbours'.[134] The Army ought therefore to consider it not because it would bring about revolutionary changes on the battlefield but because other nations were starting to take the weapon seriously.[135]

Clearly Slade believed that if the imperialists could be won over by his logistical arguments then selecting a weapon because other nations were investigating them as well might be a line of reasoning that could be used in the future to win round the traditionalists. It was, however, a disingenuous argument. For Slade recognised that more magazine arms in the hands of European Armies would exacerbate the empty battlefield phenomenon as soldiers sought cover and safety through dispersion. But instead of emphasising the way the technology might affect tactical choices he decided that a more effective argument would be to highlight the need to retain a strong sense of discipline whilst pointing out that Britain's armies ought to be armed with the most up-to-date weaponry. Whether this of and by itself would be enough to convince the sceptics was open to question. As will be demonstrated in the next section, it would take some timely advances in ammunition technology during the course of 1887 before Slade would be in a position to find out.

Unafraid of the logistical implications posed by his firepower preferences, Slade sought out alternative technical solutions to the problems faced by the other actors.

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[132] C. G. Slade, 'Modern Military Rifles and Fire Tactics', JRUSI, Vol: 32, (1888/1889); Col C.G. Slade, 'Lecture on Modern Military Rifles and How to Use Them', Aldershot Military Society, (1890).
[133] 'Trial of Magazine rifles in England, 1879', p. 30.
[134] Ibid., p. 33.
[135] Ibid., p. 33.

As a member of the Rifle Brigade, he recognised that there were some obvious advantages to be gained from a change in breech mechanism combined with a reduced calibre round and detachable magazine. In this respect Slade quite clearly took a more radical stance than those he was trying to convince. Building support for his position did not, therefore, come easily. From the Admiralty's perspective Slade's commitment to a magazine rifle was only useful if they could find agreement on a breech mechanism. When this eventually happened in 1886, the scene was set for radicals and the Navy to align themselves.

At the same time, Slade's views on tactics, reliability and logistics were more in common with those of the imperialists than they were with the traditionalists. Accordingly it could come as no surprise that he should try and appeal to the likes of Wolseley when trying to build his case for change. However, whilst agreement over tactics might keep Wolseley open to the possibility of a technical change he still needed to be convinced by the reliability of the weapon suggested by Slade. With continuing questions being raised about the falling-block breech mechanism the imperialists could no longer necessarily rely on the recommendation to adopt the Owen Jones. Consequently, armed with arguments furnished by Slade, Wolseley was prepared to consider the bolt-action breech mechanism and argue with the traditionalists about changing to a magazine arm. But it did not follow that he would be prepared to swallow Slade's argument whole. A number of issues would need resolving before that might be achieved, the most important of which was related to whether a smaller round could be sufficiently lethal. Where Slade had been successful was in changing the way in which a key protagonist saw the magazine rifle question and in this respect his importance stems from the fact that he managed to move the debate towards a more radical point of view.

Logistics, Lethality and the Lee-Metford

In September 1887, the magazine rifle committee finally recommended the LEME for adoption with the British Army.[136] By December the following year, with all the protagonists in agreement the Secretary of State for War, Edward Stanhope, accepted it into service.[137] This final section outlines the three areas around which compromise and consensus over the LEME's design was finally achieved. Of particular interest to all concerned was whether a reduced calibre round was either technically viable or sufficiently lethal. If it could be shown that it was then making the change to a smaller more deadly bullet was an attractive proposition. This in itself was not an argument for a magazine rifle but given the diminished logistical implications it did make such a proposal harder to resist. What might undermine such moves, however, were matters relating to fire control. The question was how to limit the excessive wastage of ammunition. Finding an agreement here meant re-opening questions about the detachability of a magazine. At the same time it also led to the adoption of a cut-off, a device designed to shut off the ammunition in the magazine and make it easier for the soldier to load his rifle like a Martini-Henry, single-shot weapon. Accordingly what will become clear is that when it came to the LEME all the actors could find a technical solution to their particular problems. And in this respect the weapon represented a negotiation among the various parties: an artefact around which various perspectives could coalesce.

Slade's argument with Wolseley had turned on whether the Enfield-Martini .402" round could be abandoned in favour of something smaller. In the spring of 1887 a technical solution that addressed this particular problem presented itself to the magazine rifle committee and helped propel the case he had made.[138] During the course of 1886, the Swiss Army adopted a rifle known as the Rubini whose main

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136 The decision was taken on 21st September 1887. See, 'Précis on the steps which led to the introduction of a Magazine Rifle into Imperial Service, and the subsequent action relating thereto', p. 4, 1890 Magazine Rifle, MOD Pattern Room Archive.

137 'Magazine Rifles, Pattern 1888'; pp. 27-29, 330 (200) LEME, MOD Pattern Room Archive. The Lee-Metford Mk.I, .303" was approved on 22nd December 1888, see LC. 5877, MOD Pattern Room Archive.

138 Special Committee on Small Arms, 'Report on Comparative Trial of Enfield Martini and Rubini Rifles 1887', 330 (200), MOD Pattern Room Archive.

interest from the British point of view stemmed from the fact that it fired .298" ammunition.[139] Slade could now use a solid example to show his colleagues and more importantly the wider community of interest that changing to a reduced calibre bullet was a technical possibility.

A change in calibre now rested on how lethal such a round might be. The crucial test of lethality as far as the main protagonists were concerned was whether ammunition was effective against cavalry horses. Traditionally, cavalry were used for reconnaissance, in pursuit of a fleeing enemy or as a shock formation that used the weight of a massed rank of men on horseback armed with sword or lance to charge a fixed position. If cavalry were to be defeated then it was important that the bullet that replaced the Martini-Henry's .450" round be capable of stopping a charging horse. Accordingly Lord Wolseley told the Duke of Cambridge that in his opinion, an experiment was necessary to establish whether a calibre below .402" would be sufficiently destructive.[140] The Duke agreed with the proposition and trials were organised to compare the effectiveness of the Enfield-Martini with the Rubini rifle. Clearly the benefits that could be derived from a smaller round could not simply be dismissed.

By May 1887, after extensive tests on dead horses by the Veterinary Surgeon it was found that, '...the Rubini rifle and ammunition are more destructive to animal tissues than the Enfield-Martini'.[141] Consequently in June 1887, the president of the magazine rifle committee duly reported that the committee,'...now unanimously record their conviction that the advantages offered by the small calibre are so great as to render a change in the calibre of the Service arm a matter of immediate and paramount importance'.[142] Bearing in mind the logistical concerns held by the

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[139] 'Trial of Magazine Rifles in England, 1879', p. 22; and Ibid., p. 5.
[140] 'Report on Comparative Trial of Enfield Martini and Rubini Rifles 1887', pp. 24-25.
[141] Ibid., p. 8. As will be seen in Chapter Seven, operational researchers during the Second World War subsequently came to the conclusion that a decrease in bullet mass accompanied by an increase in ammunition velocity could produce highly lethal ammunition. This was far from an uncontested scientific law. Indeed, as will become clear, the science of wound ballistics was as open to as many interpretations as the rifle technologies being discussed here.
[142] Ibid., p. 4.

imperialists this evidence was difficult to argue with. This was because a greater quantity of more destructive ammunition could be carried in the baggage train when compared to that necessary for either the Martini-Henry or the Enfield-Martini.[143] No wonder then that in September 1887 all the protagonists agreed on .303" ammunition.[144] For they did so knowing that it weighed half as much as the Mk.III Martini-Henry round and yet was more effective against horses. Slade's argument in favour of a reduced calibre had won the day. However, without the timely developments in Switzerland it is possible that the British Army might have missed the opportunity.

Nevertheless, just because the ammunition question had been settled in Slade's favour it did not follow that the protagonists would agree to the rest of his agenda. For the fact of the matter was that the Army did not have to adopt a magazine arm just because more ammunition could be carried in the supply chain. Certainly the imperialists found the prospect of a new smaller calibre, magazine rifle to be attractive. After all, they would not have to compromise on logistical or reliability matters. The question was could the traditionalists accept such a weapon if it also meant troops could fire all their ammunition without regard to the intentions of their commanding officer.

In these circumstances, what might convince the traditionalists to accept such a weapon was whether a contrivance might be found that could enable the rifle to be used like a single-shot Martini-Henry. And in this respect the magazine cut-off

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[143] The breakdown of ammunition carried by troops amounted to: 70 rounds per man, 30 rounds per Regimental reserves, 30 rounds with Division, 30 rounds with Army Corps, 160 rounds with the grand depot, 320 rounds with Ordnance Store Department. Thus the total amount of Martini-Henry ammunition initially available for a man on campaign was 160 rounds in operational areas and 480 rounds per man per rifle in rear areas. See Wolseley, The Soldier's Pocket-Book for Field Service. By contrast the LEME equipped soldier could carry twice as much ammunition as he had previously when he was armed with the Martini-Henry. The weight of the .303" Mk.I black powder cartridge was 18.5 grams. The weight of the .450" Mk.III round was 36.6 grams. Therefore, twice as much LEME ammunition could be carried for the same weight as the Martini-Henry round. See J. Huon, Military Rifle and Machine Gun Cartridges, (London: Arms & Armor Press, 1989) and P. Labbett and F. A. Brown, British Small Arms Ammunition, 1864-1938: Other than .303 inch Calibre, (London: P. Labbett, 1993).

[144] The .303" calibre was agreed on the 21st September 1887, see 'Magazine Rifle – Précis on the steps which led to the introduction of a Magazine Rifle into Imperial Service'.

developed by the Assistant Superintendent of the RSAF and patented in 1887 seemed to provide a tailor-made solution for this express purpose.[145] Designed to shut away the magazine from use, when the device was engaged, troops had to load single rounds into the firing chamber one round at a time. Soldiers could then be instructed by the commanding officer to load, aim and fire in the usual manner. Of course the men could disengage the cut-off device but whilst in locked up formation they were under close surveillance from their commanding officer and therefore vulnerable to reprimand.[146]

Accordingly, the cut-off addressed the concerns of both the traditionalists and the imperialists who all believed fire control was absolutely necessary if ammunition was to be properly conserved and appropriate military objectives achieved. More than this, the traditionalists were happy because the pernicious tendencies of the magazine could be limited for they could continue to employ fire tactics associated with the controlled use of volley fire made possible by the Martini-Henry. This in turn ensured the role of the officer relative to his men making him essential in the act of setting targets, checking range and giving instruction as to fall of shot. By contrast the imperialists could agree to the cut-off because the magazine was still available for use at critical moments in the attack or defence. Finally, the radicals could accept it because they were free to keep the device permanently disengaged.

Whereas the cut-off might not prevent the radicals using the magazine arm in a way that accorded with their particular way of seeing the battlefield, the issue of a fixed magazine certainly did. The radicals wanted to increase the quantity of fire that they could generate. A smaller more deadly bullet made this likely because it retained the advantages of the larger calibre round and at the same time made it possible to carry a greater quantity of cartridges in the supply chain. However, as far as the imperialists were concerned, neither a smaller calibre nor a magazine cut-off could guarantee that troops might not waste ammunition. At the same time, if the issue of

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145 'Magazine Rifles Pattern 1888', p. 14, 330 (200) LEME, MOD Pattern Room Archive.
146 Picq, Battle Studies, p. 96; D. Grossman, On Killing: the Psychological Cost of Learning to Kill in War and Society, (Boston: Little, Brown and Company, 1996), p. 23.

command and control was as important as the traditionalists were arguing then as much as possible should be done to prevent troops from making excessive use of their magazine.

For a number of different reasons then, both the imperialists and the traditionalists needed more reassurance if they were to agree to the Lee bolt-action. Against this backdrop, the decision to adopt the Improved Lee with the magazine screwed into the bottom of the receiver makes sense for it was a way of binding the imperialists and traditionalists together.[147] By preventing the individual soldier from replacing his spent magazine with a fresh one, troops could still potentially fire off all the ammunition loaded into the rifle, but their overall rate of fire per minute, as the magazine rifle committee had shown, would be limited by the need to reload.[148] The radicals may not have won the argument entirely but they had already moved the debate a considerable way towards their point of view. After all, there was nothing to stop the Army from choosing to unscrew the magazine at a later point.

Happily for the War Office the Royal Navy was equally persuaded by the decision to adopt the LEME. By and large the Army's specifications were within the boundaries of what the Admiralty would tolerate. Clearly the Navy was not bound by the same logistical constraints as the Army and could have insisted on a unique calibre suitable to the tactical engagements it was likely to face when engaging torpedo boats. However, the DNO obviously decided that having waited so long for the various protagonists to catch up with the Navy's views it was better to get a magazine arm in place rather than cause further delays by insisting on a different round. No wonder then that in February 1887 the DNO made it clear that the selection of a future calibre ought to be based on military grounds alone.[149] The only condition he added was that whatever was chosen ought to be interchangeable

[147] 'Trial of Magazine rifles in England, 1879', p. 24.
[148] See Tables comparing the rapidity of fire, with and without aim, of the three Magazine Rifles and the Martini-Henry Rifle in 'Reports on Trials of Various Systems of Magazine Arms, Quick Loaders etc, 1885', Appendix C, pp. 114-118.
[149] 'The Magazine Rifle', p. 9, ADM 116-349, NA.

between the services and with machine guns. This would simplify the supply chain and make it easier for Naval Brigades to operate on land.

Land operations were not, however, the main concern of the Admiralty. The bigger threat was the torpedo boat. Consequently, when the Navy indicated that they were happy with a reduced bore magazine arm what was of particular importance was the ability of the round to get to the target quickly. High muzzle velocities would ensure that ammunition could do this without the need for sophisticated sights that might need adjustment in the heat of battle.[150] Given that the torpedo boat could travel at speed, flatter trajectory bullets would make it easier for the sailor to aim at and successfully engage his target. Thus a change to smaller calibre, higher velocity ammunition was perfectly acceptable to the Royal Navy. Whether the Army decided on a cut-off or wanted a fixed magazine was not of such concern. After all the Admiralty had waited ten years to get a weapon that was almost identical – apart from some organisationally important alterations – to the one that they had examined in 1879.

Conclusion

What is clear from this case study is that the ambition to produce greater volumes of fire was not by itself driving the adoption of the LEME. Instead weapon selection was motivated by a range of factors related to the differing perspectives of four different social groups, each with their own distinct views of the battlefield. The traditionalists wanted to continue to fire shots in volleys by rank. The Royal Navy were interested in a weapon suitable for engaging motor torpedo boats as well as enabling their Marines to repel boarders and shoot at an enemy located in the fighting tops of ships. The imperialists were wary of the logistical implications that stemmed from a magazine rifle but recognised the need to adopt skirmishing tactics. At the same time the radicals wanted a rifle that would allow them to match the fire capabilities of the heavy infantry.

[150] 'Report on Comparative Trial of Enfield Martini and Rubini Rifles 1887', p. 23.

The touchstone issue for all concerned was related to the matter of fire discipline. This was important because controlling fire linked logistics to the existing state of officer-man relations. If the men were not kept under strict control when firing their weapons there was the chance that they might waste ammunition. For a number of reasons the radicals and the Royal Navy had a more relaxed attitude towards this question but that did not mean that they could avoid addressing the anxieties of those traditionalists and imperialists who were worried by the problem. When it came to the technical characteristics of the LEME, the most obvious place where this issue manifested itself was in the form of the magazine cut-off.

For those who want to argue that weapon design is simply about smoothing out engineering problems so as to increase killing efficiency, the cut-off poses some challenging questions. At first glance, the device appears unnecessary. However, by placing it within its wider socio-technical context it becomes readily apparent that it provided the means by which the traditionalists could retain control of the infantry's rate of fire and, as a result, maintain the existing state of officer-man relations. At the same time, the imperialists recognised that rapid fire could be extremely useful in emergencies so long as due consideration was paid to the supply constraints that the Army typically worked within. The device could therefore help to limit the logistical implications posed by a magazine rifle. Finally, whilst the radicals and the Royal Navy understood the preferences of the traditionalists and imperialists they could choose to use the rifle in a way that suited their tactical preferences. The success of the Lee-Metford can, therefore, be put down to the way in which it allowed each of the four groups to do what it wanted with the weapon without compelling any one party to adopt the techniques of the other. Far from simply demonstrating the increasing importance of firepower on the battlefield, the LEME is illustrative of a more complex story: one in which the rate of fire was but one and not necessarily the most important factor.

Thus, contrary to those who argue that the LEME simply reflected a pattern of technical change sweeping across the Great Powers during the 1880s, the decision by the War Office to adopt a British magazine arm was taken for unique reasons and on its own terms. Indeed, a close examination of the evidence shows that there was nothing inevitable about the choice of a magazine arm. Rather its selection can in part be put down to a series of coincidental and contingent occurrences that were not immediately within the control of the actors concerned. Without the timely development of the Rubini, for instance, there is no reason to assume that the British Army would have adopted anything other than .402" ammunition and the Enfield-Martini.

Chapter Three - The Short Magazine Lee-Enfield (SMLE)

If the triumph at Omdurman in September 1898 symbolises the apotheosis of colonial campaigning, then 'Black Week' in December 1899 must represent its nadir. Within the space of sixteen months the British Army had experienced unparalleled victory and humiliating defeat. In the Sudan 11,000 Dervishes had been killed for the loss of just 48 men.[1] By contrast in South Africa, Boer armies had won three significant battles at Stormberg, Magersfontein and Colenso. This not only stopped Britain's commander, Sir Redvers Buller, from orchestrating the relief of the sieges at Kimberley, Mafeking and Ladysmith but also prompted a national outcry and ultimately his replacement in January 1900.[2]

Omdurman had shown that the traditionalists' approach to fire tactics, built as it was around close order formations and fire by rank and volley, still had a place in the drill book. Within two years, however, the Boers had demonstrated how, through the employment of open order tactics, skirmishing and independent fire, the radical vision of battle propounded by Colonel Slade might operate. Whereas the LEME had left the tactical debate between the radicals and traditionalists open, by 1899 a new relevant group from India started to change the way in which combat problems were understood just as the likes of Wolseley and Cambridge started to leave the War Office. Derived from their experience of fighting on the North West Frontier, the 'Indians' pressed for revisions to Britain's rifle technology so that it could take into account their views on battle.

Accordingly, this chapter explores not only how the battlefield assumptions that underpinned the traditionalist perspective were no longer relevant but also how the radicals were not the driving force behind changes to equipment and training. For the fact of the matter is that the pace of transformation, both in terms of technology

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[1] E. M. Spiers, 'The Late Victorian Army, 1868-1914', in The Oxford History of the British Army, D. Chandler and I Beckett (eds.), (Oxford: Oxford University Press, 2003), pp. 206-209.
[2] Ibid., p. 200.

and technique, had more to do with the appointment in 1900 of the former Indian Army commander, Field Marshal Lord Roberts, to the position of Commander-in-Chief than it did with the success of the radicals' agenda. Indeed, it was not in Africa that the British Army's heavy infantry first learnt that open order tactics, skirmishing and independent fire were a necessary adjunct to survival on the empty battlefield but rather on the North West Frontier. Thus when in September 1903 the Secretary of State for War, William Brodrick, agreed to the introduction of the SMLE, the decision was the direct result of the efforts made by this new group of previously marginalised officers who had served in India.[3]

These 'Indians' had for a long time been involved in politicking with Wolseley and Cambridge both in relation to key War Office appointments but also with regards to the distribution of limited resources and arguments over the importance of India versus the rest of Empire.[4] However, whereas the LEME had generated a significant argument within the War Office between the traditionalists and imperialists, the Indians had not been consulted at all. This reflected the fact that the Indian and British armies were separate institutions. But it was also indicative of the underlying opinion held by many at the War Office who were suspicious of the Sepoy army following the Mutiny of 1857.[5] Consequently, located far away from the centre of power the Indians' ability to influence the debate had been constrained. Nevertheless, by 1903 the groups involved in small arms selection had significantly changed. Cambridge had retired. Wolseley had been replaced by Roberts. The Indians were ascendant at the War Office, dominating appointment, training, equipment and organisation decisions. At the same time the Boer War cemented a consensus at least in relation to small arms and fire tactics that had not previously been easy to come by in the 1880s. The selection of the SMLE was as a result considerably easier to orchestrate.

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[3] For date the SMLE was accepted into service see List of Changes, LC. 11947, MOD Pattern Room Archive.

[4] T. Packenham, The Boer War, (London: Weidenfield & Nicolson, 1979), pp. 73-73; Preston, 'Wolseley, the Khartoum Relief Expedition and the Defence of India, 1885-1900', pp. 269-270.

[5] Kochanski, Sir Garnet Wolseley: Victorian Hero, p. 222.

The Boer War also brought to light another faction, known here as the cavalry school, that had the potential to upset the Indians' ambition to make changes to the Army's rifle technology. Led by men such as Sir John French and Douglas Haig, a considerable source of friction between the two groups stemmed from the fact that neither could agree on the military utility of shock tactics. As far as the Indians were concerned tactical and technological developments made the cavalry in its existing form redundant.[6] In 1903 Roberts had insisted that the lance be abandoned.[7] The cavalry had no reason to think that the Indians would stop there for so vehement were the arguments that the dispute had the potential to spill over into decisions being made about small arms. Finding agreement in relation to the SMLE was therefore far from inevitable.

The third group considered by this chapter is made up of certain members of the National Rifle Association (NRA) and a number of sceptical politicians, including Hugh Arnold-Forster, the Secretary of State for War from 1903 until 1905. Having come to the debate after the main discussions had been settled and without any direct battlefield experiences themselves, the capacity of this final group to influence the Indians and cavalry was limited. Their ability to change small arms policy was further complicated by the fact that they were wedded to the notion that, all other things being equal, a longer barrel meant more accuracy and greater range. In an effort to change policy some politicians raised questions in the House of Lords whilst NRA members wrote of their concerns in letters to newspapers. None of this could persuade the Army to change its mind. Nor could the political head of the War Office, despite receiving assistance from groups outside government, challenge a consensus that had already formed within the Army. The SMLE gave both the Indians and the cavalry school what they needed and as a result they were not prepared to re-open the small arms question.

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[6] A fuller exposition of this can be found in S. D. Badsey, Fire and the Sword: the British Army and the Arme Blanche Controversy 1871-1921, (PhD, University of Cambridge, Cambridge, 1982).
[7] B. Bond, 'Doctrine and Training in the British Cavalry, 1870-1914', in The Theory and Practice of War, Michael Howard (ed.), (London: Cassell, 1965), p. 111.

Before proceeding it is worthwhile noting some of the technical features of the SMLE in order to prevent any confusion from arising. Like the LEME, the SMLE was a bolt-action magazine rifle. Incorporating many similar features, the breech mechanism on the SMLE was principally the same as that found on the LEME. Where the rifles most obviously differed was in relation to their length and the nature of the wooden hand guards for the barrel. The SMLE was four and a half inches longer than the carbine version of the LEME, a weapon previously provided for cavalry and artillery units, and five inches shorter than the LEME rifle formerly for use by the infantry. Unlike the LEME the barrel of the SMLE was fully encased in wood so as to act as a hand guard. This made it possible for the shooter to carry the weapon after it had fired several rounds without fear of getting burnt by hot metal. Because of its reduced size the SMLE was lighter than the LEME by 1 ¼ lbs. In addition there were a number of other modifications that had been made to the original LEME design. However, as these are bound up with the weapon's interpretive flexibility they will be discussed as the chapter unfolds.

The Indians

In many respects the Indians' views on small arms had much in common with those of Colonel Slade and the radicals. There were some differences of emphasis especially in relation to a number of technical matters but in what follows it will become clear that it was the Indians and not the radicals who were driving the changes in rifle technology in the late Victorian period. Made up of officers who had served either within the Indian Army or as part of a British unit posted to defend India, these men were united by their belief in marksmanship skills, independent fire and open order formations. The key protagonists, at least in terms of the SMLE, were Field Marshal Lord Roberts, the former Indian Army Commander-in-Chief and his protégé Colonel Ian Hamilton (eventually knighted in 1900 and made full General in 1907). This section explores their backgrounds and views on tactics and technology.

Lord Roberts originally joined the Bengal Artillery in 1851, serving with distinction during the 'Indian Mutiny' of 1857 when he won the VC and quickly rose to Colonel and Quarter-Master General in 1876.[8] Having become a full Major-General in 1878, Roberts established his military reputation beyond any doubt when he force marched 10,000 men the 312 miles from Kabul to relieve the siege of Kandahar during the Second Afghan War of 1878-1880.[9] In November 1881 he became Commander-in-Chief of the Madras Army and was promoted to Lieutenant-General in 1883. A keen shot, Roberts backed the South India Rifle Association and organised his staff into a shooting team.[10] By 1885 Roberts was Commander-in-Chief of all British forces in India making full General in 1890.[11] In 1893 he returned to England without a posting where, on half pay, it seemed he might be forced to seek early retirement. With the departure of the Duke of Cambridge and the appointment of Lord Wolseley to Commander-in-Chief in 1895, Roberts was saved from this possibility and appointed Commander-in-Chief of Ireland. Following 'Black Week', Roberts replaced General Buller and took command of British forces in South Africa. By November 1900, having occupied Bloemfontein and Pretoria, the capitals of the Boer Republics, he returned to Britain to take up the position of Commander-in-Chief.

Roberts was very keen to improve the standard of rifle shooting within the Indian Army.[12] To this end he appointed Ian Hamilton to be Assistant Adjutant-General of Musketry at the Madras Army Headquarters in the spring of 1882.[13] After attending the School of Musketry at Hythe, Hamilton worked studiously to improve the skills of his regiment, the Gordon Highlanders. Training his regiment to shoot was not, however, what attracted the attention of the Lord Roberts. Rather, Hamilton first came to the notice of Roberts during the Second Afghan War where he demonstrated

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[8] A. Wessels (ed.), Lord Roberts and the War in South Africa, 1899-1902, (London: Sutton Publishing, 2000), p. xiv.
[9] Ibid., p. xiv.
[10] D. James, The Life of Lord Roberts, (London: Hollis & Carter, 1954), p. 191.
[11] Wessels (ed.), Lord Roberts and the War in South Africa, 1899-1902, p. xv.
[12] James, The Life of Lord Roberts, p. 191-192.
[13] J. Lee, A Soldier's Life - General Sir Ian Hamilton, 1853-1947, (London: Pan Books, 2000), p. 19.

courage in retaking a picket after it had been abandoned by some British troops.[14] Known as a brave officer and to have served with distinction in India and during the First Boer War of 1881, Hamilton reinvigorated musketry drill in India.

This was achieved in a number of ways. Firstly, Hamilton set about completely re-writing the Indian Army's musketry regulations. Then having made several changes to the layout of the four rifle ranges in India he ensured that Indian Army officers and men could for the first time take advantage of the facilities to practice their shooting.[15] Musketry training was no longer simply about striking a bull's eye at certain set distances but rather also involved higher instruction on hitting moving objects such as the running deer or targets that sprung up from the ground. All conceived of in the first instance by Hamilton, the drill book and butts now reflected what he considered to be the most important aspects of rifle shooting: individual initiative and marksmanship.[16] These ideas were further expounded in his 1885 book *The Fighting of the Future* where Hamilton argued that, '...the paramount desideratum in a fighting man is, that he should shoot intelligently and well...'.[17] Later on in life when questioned about his experiences during the Second Boer War it would become clear that Hamilton's views on marksmanship had hardly changed throughout his career as a professional soldier.[18] That aside, what was apparent in the 1880s was that Hamilton had the full support of Roberts. With so much importance being attached to it by such a senior commander there could be no doubt that the Indian Army's skill at arms would have to improve. What would prove to be annoying for the likes of Wolseley and Cambridge at the War Office was that, despite initially rejecting the proposal, they were forced into adopting the Indian system of musketry training in order to ensure that British units kept up.[19] The real

[14] Ibid., p. 12.
[15] The ranges were located at Pachmarhi, Chugla Gully, Secunderabad and Deolali. See 'Musketry and Field-Firing', Pioneer, February 15th 1890, Hamilton Papers 17/2, Liddell Hart Centre for Military Archives (LHCMA).
[16] Lee, A Soldier's Life - General Sir Ian Hamilton, 1853-1947, p.19.
[17] Capt. I. S. M Hamilton, The Fighting of the Future, (London: Kegan Paul, 1885), p. 14.
[18] Evidence given by Lieutenant-General Ian Hamilton to the Royal Commission of the War in South Africa (RCWSA), 12th February 1903, Vol. 2 Minutes of Evidence, p. 112, RCWSA.
[19] Lee, A Soldier's Life - General Sir Ian Hamilton, 1853-1947, p. 20.

British school of musketry, one Indian paper commented, '...is at Simla and not Hythe'.[20]

Nevertheless, competition between the British and Indian armies was not the main reason for Roberts' interest in musketry training. Rather his concerns were motivated by the problem of defending the difficult mountainous terrain on the North West Frontier.[21] Stimulated by the possibility that the Russians might use the country as a staging post for the overland invasion of India, Britain's involvement in Afghanistan was limited to preventing invasion and keeping the restive Pathan tribes from attacking the Punjab. This was not achieved simply by manning fixed fortifications but by regular patrols to gather intelligence and suppress tribal factions and by buying the support of key tribesmen through trade and bribery.[22] Occasionally, a major expedition had to be organised in order to assert British interests in the region and it was invariably whilst undertaking these activities that the traditionalists' approach to drill came under close scrutiny. The fact of the matter was that hill fighting required a fundamentally different set of tactical skills from those used by heavy line infantry.

Compared to colonial campaigning in other parts of the Empire, Afghans fought with a skill that was unmatched. Occasionally the Pathans would launch sword wielding charges that could easily be repelled by volley fire. More fruitful tactics involved taking advantage of the terrain and shooting their enemies from behind cover.[23] In these circumstances close order formation and volley fire were a lethal combination: not for Afghans but rather for those British battalions which utilised such tactics. This was because standing in the open, shoulder to shoulder, made for an easy target for Pathan sharpshooters. Afghans could use the time between each volley to bob up from behind a rock to pick off individual soldiers. Winston

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[20] 'Musketry in India', Broad Arrow, 16th July 1892, Hamilton Papers, 17/3/2, LHCMA.

[21] A fuller description of the various geographical and climactic features found on the North West Frontier can be found in T. Moreman, The Army in India and the Development of Frontier Warfare, 1849-1947, (Basingstoke: Macmillan, 1998), pp. 1-4.

[22] Ibid., p. 5.

[23] Ibid., pp. 12-13 and p. 63.

Churchill noted that, 'tribesmen... dart from rock to rock... before the attention of a section could be directed to them and the rifles aimed... the target would have vanished...'.[24] Wearing distinctive dress, responsible for command and control and orchestrating the fire of their men, officers were particularly vulnerable to this kind of fire.[25] At the same time the LEME rifles available to British infantrymen were not light enough to facilitate snap shooting at moving targets that were often at higher elevations. As a result the technology had the potential to reinforce a tactical approach inappropriate for the terrain, a situation that was to come to a head during the Tirah Campaign of 1897-98 where the traditionalists' approach to infantry drill was put to the test.[26]

Compared to other campaigns on the North West Frontier, the Tirah saw the British and Indian Armies facing an enemy armed with a high proportion of breech-loading and long range rifles.[27] While the Pathans had been armed with muzzle-loading muskets and home-made rifles the level of threat could be countered without restricting speed of manoeuvre. However, as the tribesmen acquired rifled weapons with modern ammunition British commanders were compelled to throw out pickets on hilltops along the line of advance.[28] This helped to protect the main column but restricted movement. Given the large distances the Army needed to traverse in order to suppress revolt this could severely limit operations.

Bearing in mind the reforms put in place by Roberts and Hamilton, Indian Army units, especially when recruited from mountainous regions, were in a better position to face the onslaught. British battalions, by contrast, suffered, partly because of the way in which some were wedded to the drill book and unwilling to learn from their

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[24] W. Churchill, The Story of the Malakand Field Force, (London: Longmans & Co. 1899), p. 285.
[25] Ibid., p. 289.
[26] N. Evans, From Drill to Doctrine: forging the British Army's tactics, 1897-1909, (PhD, King's College London, London, 2007), pp. 27-71.
[27] Ibid., pp. 34-35.
[28] See the T. Moreman, 'The Army in India & Frontier Warfare 1914-1939', found at http://www.king-emperor.com/article4.htm, site visited on 20th September 2007.

more experienced Indian counterparts.[29] With close order volley fire likely to result in unnecessary casualties, the tactics most appropriate for mountain warfare included skirmishing skills such as the use of open order formation, independent fire, stalking and field craft.[30] As these tactics could not be controlled by word of battalion commanders, officers and men had to be more self-reliant and willing to use their initiative when confronting unplanned situations. Despite their best efforts, however, the Native Army was often let down by the standard of their equipment. Armed with the Martini-Henry, a weapon which still utilised black powder ammunition, tactical achievements could be undone and positions given away when troops fired their first shot.[31] But technology aside, the Indian Army was in many ways better prepared for warfare in the hills compared with their counterparts in the British Army.[32]

Given the casualties that occurred in the first year of the campaign, the Tirah expedition caused a considerable shock within the British military establishment.[33] The response of the Indian Army was to cement an already familiar approach to low level initiative and small unit tactics by issuing a new manual in 1900 called *Mountain Warfare*. The reaction from the War Office was to appoint Ian Hamilton to become Commandant of the School of Musketry at Hythe. Accidental injury had prevented Hamilton from serving with any distinction in the Tirah.[34] However, his enthusiasm for musketry made him a natural choice for General Sir Evelyn Wood, the British Army's Adjutant-General.[35] Having taken this new post, Hamilton was in a position to do for the British Army what he had tried to achieve for the Indian Army. At the same time, in terms of the SMLE story, the appointment was crucial for it ensured that an Indian was well placed to express their views on matters

[29] Moreman, The Army in India and the Development of Frontier Warfare, 1849-1947, pp. 71-72.
[30] Ibid., pp. 13-24.
[31] Evans, From Drill to Doctrine: forging the British Army's tactics, 1897-1909, p. 46.
[32] It should also be noted that following the campaign the Indian Army was first to be equipped with the SMLE. This was partly because the Indian Government had a budget surplus of £1million. See, letter from Secretary of State for War to Chancellor of Exchequer, 8th December 1903, Arnold Forster Papers, 50306, British Library (BL).
[33] Evans, From Drill to Doctrine: forging the British Army's tactics, 1897-1909, p. 35.
[34] Lee, A Soldier's Life - General Sir Ian Hamilton, 1853-1947, pp. 40-42.
[35] Ibid., p. 43.

relating to small arms. This was to prove important in 1898 when a small arms committee was established by Field Marshal Wolseley to look at whether the LEME ought to be replaced.[36]

The idea of changing the infantry's rifle for a shorter weapon had first surfaced in December 1895 when Colonel Lockyer, the Chief Inspector of Small Arms, had suggested that the entire Army should use carbines.[37] Carbines had short barrels and were usually issued to cavalry and artillery units that needed personal firearms but whose main role did not involve the use of small arms fire. This could put these units at a disadvantage if they were forced to take on infantry in unfavourable circumstances. This was because the carbine's shorter barrel allowed the combustion energies created in the firing chamber to dissipate before they had been fully utilised to propel the bullet. Consequently, a typical carbine was effective out to a shorter range when compared to a rifle. On the other hand the LEME carbine which had been adopted in 1894 was 9½ inches shorter and weighed 1lb 13oz less than the conventional weapon and was as a result considerably handier to use.[38] It was therefore easier to pick up and aim: an important consideration when taking snap shots at moving targets.

Nevertheless, all the while the carbine fired black powder ammunition it would be at a range disadvantage when compared to a rifle. However, during the early 1890s this situation began to change as a safe manufacturing process for cordite - the British design of smokeless propellant - was perfected.[39] All other things being

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[36] Arnold Forster Papers, 50315, BL.

[37] Letter entitled 'Carbine in Lieu of the Rifle' from CISA to IGO, 20th December 1895, SUPP 6-651, National Archive (NA).

[38] Ibid.; <u>Textbook of Small Arms</u>, (London: HMSO, 1929), p. 7; see List of Changes, LC. 7751, MOD Pattern Room Archive.

[39] Whilst subsidiary to the main arguments advanced in this chapter, it is important to note, from a socio-technical perspective, that the selection of cordite was not the result of a simple or inevitable technical trajectory. In fact the War Office decision to adopt the propellant was mired in a number of commercial scandals that were passing through the courts during the early 1890s. Lord Rosebury's Liberal Government was forced out of office in 1895 in what became known as the 'cordite scandal'. The origins of this affair lay in the way the War Office managed the relationship between the Explosives Committee appointed by the Duke of Cambridge in 1888 and those private inventors who put forward designs for consideration by the government. Both Sir Frederick Abel and Sir James

equal, the energy created by cordite was greater than that produced by black powder.[40] As a result muzzle velocities could be increased and bullets propelled with a flatter trajectory. Smokeless powders consequently had a number of tactical advantages that made their selection desirable.[41] Flatter trajectories meant that soldiers had to make fewer compensatory adjustments to their aim, thereby making it easier to hit a target. This reduced ammunition wastage. At the same time, this new ammunition ensured the shooter's position was not revealed when he fired. This would not be such an important consideration when fighting against poorly armed foes like the Dervish, but when up against men armed with equivalent technology the empty battlefield phenomenon would be exacerbated.

As Colonel Lockyer had observed these were not the only possible advantages to come from a change to cordite. Faster muzzle velocities meant that weapons with shorter barrels such as the LEME carbine could achieve similar range and accuracy results when compared to LEME rifles.[42] Although cordite propellant was subsequently adopted even for the LEME, according to Sir Henry Brackenbury it

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Dewar had developed cordite which they claimed was an adaptation of the powders submitted to them whilst they were members of the Explosives Committee. As a result of several explosions of a prototype version of the propellant at the Royal Gunpowder Factory at Waltham Abbey critics were left deploring the War Office's decision to use a design which private inventors and industry believed to be inappropriate and possibly stolen. When the War Office was forced to explain itself it emerged that neither Abel nor Dewar had paid royalties for any of the ideas submitted to the Government. Moreover, unable to make any money from the patent in Britain, Abel and Dewar patented the invention in European countries so they might personally profit from cordite. Both Alfred Nobel and Hiram Maxim subsequently decided on legal action in order to uphold their rights over what they believed to be their invention. With the legality of the War Office's actions being decided in the courts, some military concern about the utility of the powder and a limited amount of ammunition in the reserves, the government was held to a vote in Parliament which aimed to reduce the pay of the Secretary of State for War. When this vote was lost, the Liberal Party was forced to resign from office. See various articles in 'Arms and Explosives' dated from 1892 to 1895 and specifically 'Arms and Explosives – A Technical Trade Journal', "Cordite in Parliament", (1893) No. 13 Vol. II, p. 2. See also C. Trebilcock, 'A "Special Relationship" - Government Rearmament and the Cordite Firms', Economic History Review, Vol: 19 No: 2 (1966), p. 376; R. Amiable, 'Scientific Reasoning and the Empirical Approach at the Time of the European Invention of Smokeless Powder', in Gunpowder, Explosives and the State - A Technological History, B. J. Buchanan (ed.), (Aldershot: Ashgate Publishing, 2006), pp. 345-346; and R. Rice, 'Smokeless Powder: Scientific and Institutional Contexts at the End of the Nineteenth Century', in Gunpowder, Explosives and the State - A Technological History, B. J. Buchanan (ed.), (Aldershot: Ashgate Publishing, 2006), p. 357.

40 Reynolds, The Lee-Enfield Rifle, p. 30.

41 Ibid., p. 30.

42 'The Evolution of Small Arms', The Times, 1st July 1898.

was clear that Lord Wolseley was not in favour of adopting a carbine for the Army.[43] Almost certainly this was because, in the Commander-in-Chief's opinion, long barrelled rifles meant increased range which was more important to him than weapon handiness. For despite his attitudes towards open order formations and drill it is likely that Wolseley still believed long range volley fire by company or section had some battlefield utility when a beaten zone was needed to destroy a large body of advancing enemy in close order formation.[44]

Wolseley's rejection of Lockyer's suggestions presented some technical and financial challenges. Cordite's increased heat encouraged wear and tear especially at the breech end of the LEME's barrel.[45] If costs were to be minimised and weapon efficiency maintained then a technical solution to the problem had to be found. The RSAF's answer was to develop Enfield rifling for the LEME.[46] This prolonged the life of the barrel and led to the introduction of the long Lee-Enfield rifle and its carbine equivalents in 1896 and 1898 respectively.[47] The decision to adopt the Lee-Enfield was therefore most probably a bi-product of Wolseley's views on the importance of long range fire. But Lockyer's memo also raised the possibility of a lighter rifle. If such a thing was possible without sacrificing Wolseley's range requirements then the Army might abandon both the LEME and the Lee-Enfield

[43] Arnold Forster Papers, 50315, BL.

[44] Wolseley's views on this can be found in Brackenbury, 'The Latest Development of the Tactics of the Three Arms', , p. 482. Although this article does not provide contemporaneous evidence it is likely, given the British Army's engagement in the Sudan in 1898, that Wolseley still saw some utility in the use of long range volley fire. A beaten zone is the area of fallen shot between the first catch and the last graze of a bullet's trajectory. In the British Army it was usually produced by groups larger than sections who fired by volley. Such tactics were only used to engage targets at extreme ranges greater than 2000 yards where even high velocity ammunition would not be effective unless the rifle was raised to allow gravity to assist the bullet's flight. In these circumstances fire could not be aimed in the traditional manner: looking down the iron sights located along the length of the barrel. Instead the LEME, Lee-Enfield and SMLE had a dial sight attached half way down the length of the wooden hand guard. By elevating the rifle upwards the shooter could look through an aperture sight located to the side of the receiver to the dial sight and as a result zero in on targets out to the 3000 yards. The maximum range marked on the SMLE's dial sight was 2800 yards. For a description of the dial sight in use see, Reynolds, The Lee-Enfield Rifle, p. 59.

[45] Reynolds, The Lee-Enfield Rifle, p. 30.

[46] i.e. a change in the pattern of grooves within the barrel of the rifle from Metford to Enfield design. Ibid., p. 37.

[47] See List of Changes, LC. 8196 and LC. 8390, MOD Pattern Room Archive.

sooner than later. Accordingly in 1898 Wolseley, whilst Commander-in-Chief, directed that further investigations be undertaken into a new rifle for the Army.[48]

It was at this point that Ian Hamilton entered the picture. With his arrival at Hythe, Hamilton was in the perfect place to influence the design of small arms based on his experience of fighting on the North West Frontier.[49] Hamilton was chairman of a new Small Arms Committee made up of three men, one of whom included the CISA, Colonel Lockyer. Charged with investigating whether a new lighter rifle should be introduced the committee drew up a short list of weapons for consideration and further examination. By April 1899, having examined four possible firearms including Lockyer's carbine and a number of modified shortened Lee-Enfield rifles, the committee made its recommendations.[50] Lighter weapons were preferred because they would make it easier for the soldier to take a snap shot at a moving target. Achieving this without reducing the length of the rifle would be too difficult. Accordingly, the decision was taken to lighten the rifle by shortening its barrel, take advantage of cordite ammunition but avoid compromising on weapon range. In this respect Lockyer's carbine suggestion was rejected because its barrel was too short but one of the other modified Lee-Enfields appeared to provide a relatively simple solution to the weight problem and for this reason it was put forward by the committee.[51] Unfortunately for the Indians, before the matter could be investigated further the Boer War had started. However, by the time the issue was considered again Wolseley had been replaced by Roberts and the Wolseley ring had collapsed.[52] If Wolseley had been left in office long enough, there might have been more argument within the War Office over what would replace the LEME. As it was events not only made it possible for the Indians to influence the design of

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[48] Arnold Forster Papers, 50315, BL.
[49] Ibid. Although there is no explicit evidence to substantiate the point, Hamilton's appointment was almost certainly made by the Adjutant-General, Sir Evelyn Wood. Wood had appointed Hamilton to Hythe despite the fact that Hamilton was not part of the Wolseley ring. That Wood managed to achieve this was probably a result of Wolseley's failing health.
[50] 'The New Rifle – Memorandum by the Secretary of State for War and Replies by Sir Henry Brackenbury, Director General of Ordnance,' 29th April 1903, Arnold Forster Papers, 50315, BL.
[51] Ibid.
[52] Kochanski, Sir Garnet Wolseley: Victorian Hero, p. 272.

small arms in the first place but also ensured there would be little resistance to their views from other protagonists. This made the decision to abandon the LEME and Lee-Enfield easier to orchestrate. With several important modifications, the weapon that Hamilton's committee recommended in 1899 would eventually become the SMLE in 1903. Before that ambition could be realised, however, circumstances would also have an impact on the Indians and their views on what should replace the LEME.

The Boer War 1899-1902

The Boer War proved to be extremely controversial for the British Army. Half a million British and colonial soldiers fought around 78,000 Boers over a two and a half year period.[53] The war progressed in a number of phases. In the first, the Boers staged a limited offensive that resulted in the siege of Kimberley, Mafeking and Ladysmith. In the second, Buller's counter offensive was repelled leading to his replacement by Field Marshal Roberts. In the third, Roberts would launch successful attacks towards Bloemfontein and, before the end of 1900, occupy the capitals of the Orange Free State and the Transvaal. In the final phase, Roberts would return home to become Commander-in-Chief and Lord Kitchener would take the fight to the Boers who were waging a guerrilla campaign. In terms of the SMLE story, Buller's defeat heralded the collapse of the Wolseley ring and ensured that the small arms debate would change in favour of the Indians. However, the war also influenced the Indian view of tactics and small arms technology and helped raise to prominence the second important interest group known here as the cavalry school. This section is therefore concerned with how the Boer War affected technical decisions in relation to the SMLE.

It is not easy to make generalisations about the British Army's performance during the war without being overly simplistic. Some units fought well, demonstrated an appreciation of the battlefield problems that they faced and used appropriate tactics to achieve victory. Others did not. At Elandslaagt in 1899, for example, Ian

[53] Wessels (ed.), Lord Roberts and the War in South Africa, 1899-1902, p. xiii.

Hamilton organised a successful attack on Boer positions that involved infantry in open order formation, a flanking manoeuvre and cavalry.[54] On the other hand Major-General Hart at Colenso demonstrated the error of traditionalist, sometimes described as Aldershot, tactics when he marched the Irish Brigade in close order up to the Boer lines only to get severely mauled by a hidden enemy firing smokeless .276" Mauser ammunition.[55]

Veterans of the North West Frontier recognised the similarities between the way the Boers and Afghans fought. On the defensive the Boers could easily hide themselves along a geographical feature, firing on the British as targets revealed themselves, knowing that their smokeless ammunition would not give them away.[56] But when on the attack they could be reckless, especially when facing inexperienced or poor quality troops with poor marksmanship skills. As Hamilton observed, in these circumstances the Boers would be more than happy to ride their ponies close to British lines and shoot from horseback before riding away.[57]

Within a month of arriving at Cape Town, Roberts issued several memoranda to all commanders providing explicit guidance on what tactics ought to be utilised in fighting in South Africa.[58] This drew on his experience of war on the North West Frontier. Not only did it make it clear that open order was to be the norm and not the exception but, given the Boers' tactics, banished the use of volley fire as standard battlefield practice. Roberts recognised that open order formations might cause command problems for battalion and company commanders unused to light

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[54] N. Evans, 'Boer War Tactics Re-Examined', JRUSI, Vol: 145, (2000), p. 71.

[55] Packenham, The Boer War, pp. 225-228; for an excellent account of the variety of weapons used by the Boer Armies see Ron Bester, Boer Rifles and Carbines of the Anglo Boer War, (Bloemfontein: War Museum of the Boer Republics, 1994).

[56] Undated anonymous note, Hamilton Papers, 2/3/34, LHCMA; Letter from Lord Roberts to Sir Henry Fletcher Bart, 1st January 1901, WO 108/411, NA.

[57] Letter from Sir Ian Hamilton to his wife, 12th November 1901, Hamilton Papers, 2/2/7, LHCMA. In evidence provided to the Royal Commission for the War in South Africa, Lord Roberts stated that British troops were better at shooting at, '"long distances" than they were at short distances, but they were nothing like as good as "the Boers at the short distances"'. See Vol. 1, p. 48, RCWSA.

[58] 'Notes for Guidance in South African Warfare', issued 5th February 1900, Vol. 1, Appendix 2, pp. 531-532, RCWSA.

infantry tactics and suggested the use of whistle commands as a stop-gap.[59] The solution was hardly ideal but given the general level of the Army's skirmishing skills there were few alternatives available.

At the same time Roberts appreciated that one way of increasing the shooting prowess of the Tommy was to change the rifle in such a way as to make it more convenient, given battlefield conditions: to take away any technical encumbrances that might inhibit its use. Thus from the technology perspective, by November 1900 Roberts was telling the Secretary of State for War, Lord Lansdowne, that he believed a new weapon along the lines recommended by Hamilton in 1899 ought to be further developed and adopted by the British Army as a whole.[60] He even went further and stated that it might be appropriate to look at smaller calibres than the .303" round: the .276" Mauser had clearly made an impact with all those who were on the receiving end of its fire.

Roberts' view on changing calibre was eventually abandoned for financial reasons.[61] Nevertheless, the fact that he was considering it provides some insight on his views of the battlefield. For, depending on the precise design, changing to a smaller calibre might also relieve some of the logistical constraints that affected the British Army. By decreasing the size of the round it would be possible to carry more ammunition in the supply chain without increasing the overall volume or weight of baggage transported. This was an attractive proposition because, as Lord Kitchener had observed, the men were invariably reluctant to fire independently without direction from more senior authority.[62] In Kitchener's mind the problem was not over expenditure of ammunition caused by unsanctioned use of the magazine but rather encouraging the initiative of the soldier to open fire when presented with a viable target.[63] It seemed that so much effort had been expended on drumming

[59] Ibid., pp. 531-532.
[60] Telegram No. 1369 to Secretary of State for War from Lord Roberts, 18th October 1900, WO 108/411, NA.
[61] Arnold-Forster Papers, 50315, BL.
[62] Vol. 1, RCWSA, p. 46.
[63] Ibid., p. 46.

home the fact that the British Army fought at the ends of a lengthy supply chain that it had been forgotten that one of the objectives of battle was to kill the enemy.

One of the driving ambitions behind the Indians' decision to adopt the SMLE in 1903 was, therefore, the need to encourage soldiers to make more independent use of their rifles to engage with targets of opportunity.[64] This was not a new idea. On the basis of his experience in India, Hamilton had suggested as much in 1899. What the Boer War did was to drive home the need for technical change in order to tighten up the relationship between the design of the rifle and the way it was to be used. Reducing its length and weight whilst removing the magazine cut-off was seen as a means by which a soldier might be encouraged to use his rifle when appropriate.[65] Although the cut-off was eventually retained, mainly because of concerns expressed by native army commanders who valued the discipline of single-shot fire, the fact was that the Indians were keen to remove it.[66] The main reason why they wanted to make these changes was because they accepted the need to remove devices that made it possible to restrict the rate of fire thereby making it easier for the men to use their weapon as dictated by the needs of the battle.[67]

At the same time, the number of rounds held in the magazine was increased from eight in the LEME to ten in the SMLE.[68] This change, whilst seemingly minor, meant that troops could generate more fire before having to reload. But it was the decision to provide a magazine charger that really made it possible to increase the rifle's rate of fire.[69] Previously it had been necessary for the LEME to be reloaded one round at a time. This new device held five rounds that could, when placed on a metal bridge over the receiver, allow ammunition to be slid into the magazine. As a

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[64] 'Memorandum by Secretary of State for War and Replies by Sir Henry Brackenbury, DGO, 1903', Arnold Forster Papers, 50315, BL.
[65] Major R. J. Makur, 'New Short Rifle - Summary of Leading Facts', Arnold Forster Papers, 50315, BL.
[66] Reynolds, The Lee-Enfield Rifle, pp. 90-91.
[67] 'Memorandum by Secretary of State for War and Replies by Sir Henry Brackenbury, DGO, 1903', Arnold Forster Papers, 50315, BL.
[68] Reynolds, The Lee-Enfield Rifle, p. 83.
[69] Ibid., p. 81.

result the magazine could be recharged more quickly five rounds at a time.[70] The cumulative effect of all these changes was to give soldiers more flexibility in the use of their weapon, allowing them to engage with targets at a speed appropriate for the particular engagement. Clearly the logistical concerns advanced by the Imperialists during the 1880s were not so important to the Indians. Nor, it would seem, did they distrust the soldier in quite the same way as the traditionalists.

The enemy, both in India and South Africa, had adopted tactics of concealment based on their superior knowledge of the terrain and their mobility. This was compounded by the way in which smokeless powders made it considerably harder to identify their location. As far as the Indians were concerned a weapon that was easy to reload, did not hinder movement and made it easier to bring up to the eye to aim by being both lighter and shorter only served to encourage its use against elusive targets. And in this respect the SMLE was a rifle that, for the first time, reflected the problems associated with the empty battlefield. In conjunction with ammunition that utilised cordite propellant, the weapon was designed to allow the soldier to engage the enemy quickly whilst remaining concealed.

The Cavalry School

Whereas the infantry were primarily armed with rifles, the cavalry's traditional weapon was the sword, also known as the *arme blanche,* or the lance. The value of these arms was entirely dependent on the cavalryman remaining in the saddle. If for whatever reason, however, he was forced to fight on foot then he would have to make use of his secondary weapon, the carbine, so that he might engage the enemy by fire rather than shock action. For the cavalry enthusiasts such as Sir John French and Douglas Haig, engaging the enemy with fire did not encapsulate the role, ethos and spirit of the cavalry. Instead they preferred to make use of the *arme blanche* which they believed summed up the cavalry philosophy, a philosophy that

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[70] At the Battle of the Marne in 1914, the Germans believed they were being fired on by machine guns when in fact they were being engaged by riflemen armed with the SMLE. See, J. Keegan, The First World War, (New York: Vintage Books, 2000), p. 109.

emphasised *élan*, daring and a willingness to take risks in order to deliver victory.[71] As far as the Indians were concerned the Boer War had definitively demonstrated the bankruptcy of tactics that depended on the shock of the charge.[72] Instead they advocated reforms to the cavalry's armament, furiously rejected by the cavalry school, such that the sword would become the adjunct to the rifle. With these arguments forming the background to the small arms debate this section seeks to show why the SMLE was acceptable to the cavalry.

Both Sir John French and Douglas Haig went on to become Field Marshals responsible for commanding the British Expeditionary Force in France during the First World War. Whilst it would be a mistake to assume that their passion for the horse resulted in inappropriate tactics that culminated in the Somme,[73] it is fair to say that both men believed in the utility of the cavalry. This had been demonstrated to them during a number of campaigns where mobility was extremely important. In the case of Sir John French this was first established during Wolseley's attempts to relieve Gordon in Khartoum. As a member of Stewart's desert column, French had shown ability and courage maintaining control of the cavalry contingent and was subsequently appointed a Lieutenant-Colonel in 1885.[74] After becoming the commander of the 19th Hussars in 1888 and taking his regiment to India in 1889 he became a Colonel in 1895. In the same year Sir Redvers Buller, then Adjutant-General, asked French to re-write the manual on cavalry drill.

In 1899, upon taking up his appointment as commander of the 1st Cavalry Brigade at Aldershot, French met Douglas Haig. Haig had previously shown exemplary service commanding Egyptian cavalry during the Second Sudan War of 1898 and upon his return to England was made French's Brigade Major.[75] The two men were to serve

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[71] Marquess Anglesey, A History of the British Cavalry: 1816-1919, Volume 4, (London: Secker and Warburg, 1986), p. 408.
[72] James, The Life of Lord Roberts, p. 451.
[73] J. Terraine, Douglas Haig, The Educated Soldier, Cassell Edition, (London: Cassell, 2005), pp. 13-14.
[74] R. Holmes, The Little Field Marshal - A Life of Sir John French, Cassell edition, (London: Cassell, 2005), pp. 34-41.
[75] Terraine, Douglas Haig, The Educated Soldier, pp. 15-22.

together with some distinction during the Boer War. In 1899, Buller asked French to command the 1st Cavalry Division. Prior to taking control of the cavalry, French and Haig found themselves working alongside Ian Hamilton during the siege of Ladysmith. After having escaped, the two men went on to engineer the defence of the Colesberg area of the front: the only successful operation prior to Buller's replacement.[76] With Robert's arrival early in 1900 the Cavalry Division formed part of the force assembled for the march on the Boer capitals. It was at this juncture that the relationship between the Indians and the cavalry school became strained.

The Cavalry's battlefield problems arose as a result of the increased availability of sophisticated munitions technology that complicated the tactical picture. Smokeless propellants made it difficult to identify where the enemy was located.[77] High explosive shells, known in Britain as Lyddite, held out the prospect of improving the destructiveness of artillery bombardments.[78] In such circumstances the trooper, riding on his horse, was particularly vulnerable and his ability to charge a mass of visible enemy located in the open not only difficult but, given the nature of the empty battlefield, extremely unlikely.[79]

In Lord Roberts' opinion these technological developments had compromised the military utility of the cavalry. He noted that during the Boer War the cavalry had neither mounted an effective charge nor dismounted regularly enough to make use of their carbines.[80] At Poplar Grove in March 1900, the Cavalry Division failed to cut off a retreating Boer army. To French, this was caused by problems within the remounts department and a lack of horse fodder.[81] But as far Roberts was concerned the failure only served to underline the cavalry's ineffectiveness as demonstrated by

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[76] Holmes, The Little Field Marshal - A Life of Sir John French, pp. 71-81.
[77] For a fuller description of the smokeless ammunition, rapid firing small arms available to the Boers see Bester, Boer Rifles and Carbines of the Anglo Boer War.
[78] Packenham, The Boer War, p. 203.
[79] E. M. Spiers, 'The British Cavalry, 1902-1914', Journal of the Society for Army Historical Research, Vol: LVI, (1979), p. 76.
[80] Sir John French admitted as much whilst still in South Africa in November 1900, see 'Report on the Organisation and Equipment of Cavalry' by General Officer Commanding Cavalry Division, WO 108/250, NA, p. 12; for the views of Roberts see, James, The Life of Lord Roberts, p. 451.
[81] Holmes, The Little Field Marshal - A Life of Sir John French, pp. 97-100.

its poor horsemanship.[82] Regardless as to which of the protagonists was right, the incident continued to cause friction.

Unfortunately for the likes of French and Haig who were still in South Africa, when Roberts returned home he was able to use his position to influence how the cavalry would be equipped in the future without facing significant opposition. What the Commander-in-Chief decided was that the *arme blanche* should be secondary to the rifle. Indeed, in the service manual '*Cavalry Training*' published in 1904, Lord Roberts wrote what would become an inflammatory preface which stated his views clearly on the role and usefulness of the cavalry and asked that, in the future, training reflect the nature of the firepower dominated battlefield.[83] As far as he was concerned the cavalry ought to have first-rate rifles and emphasise the use of fire tactics in their training.[84] Accordingly, in 1901 Roberts moved to amend the armament of the cavalry. The lance was abolished except for ceremonial and policing duties whilst the sword would be retained but only as an adjunct to the rifle.[85] In the future the rifle would be kept strapped to the man (rather than in a bucket on the horse) in case the man was separated from his mount.[86] The trooper would as a result be ever ready for dismounted combat.[87] At the same time he would be sufficiently well trained to use the sword should an unusual situation on the battlefield make such tactics appropriate.

Needless to say the cavalry officers disagreed with the balance of Roberts' decisions. They understood the necessity to train the cavalry in the use of a rifle but they firmly believed in the virtue of the *arme blanche.*[88] In their opinion the problem was not with their role or training but was the result of being equipped with

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[82] Ibid., pp. 97-100.
[83] See Anglesey, A History of the British Cavalry: 1816-1919, Volume 4, pp. 396-397.
[84] Spiers, 'The British Cavalry, 1902-1914', pp. 73-74.
[85] Anglesey, A History of the British Cavalry: 1816-1919, Volume 4, pp. 391-392; Bond, 'Doctrine and Training in the British Cavalry, 1870-1914', pp. 111-112.
[86] Anglesey, A History of the British Cavalry: 1816-1919, Volume 4, p. 397.
[87] Spiers, 'The British Cavalry, 1902-1914', pp. 71-72. During the Second Afghan War, Roberts observed how the cavalry could be rendered completely ineffectual if the troopers had been thrown from their horses whilst their carbines were in bucket on the saddle.
[88] 'Report on the Organisation and Equipment of Cavalry', 8th November 1901, WO 32/6781, NA.

a carbine.[89] Several cavalrymen claimed that having a weapon with a shorter barrel than the ordinary rifle was iniquitous when confronting the Boer Mauser.[90] Such a suggestion may have been a ploy by the cavalry school to throw attention away from the man behind the weapon and onto the rifle itself. But in either case the complaint about the carbine threw doubt on Roberts' argument that the cavalry had not dismounted often enough to make effective use of their secondary weapons.[91] The fault was not with the cavalry itself but the poor choice of equipment that they had been forced to accept.

Accordingly, the main reason why the cavalry school was keen supporters of the SMLE was because they believed it would put them on an equal footing with the infantry should they be forced to dismount.[92] The encumbrance of having a longer weapon than the carbine could be balanced against the advantage of having the same firepower capability as the infantry.[93] With a wooden hand guard that covered the entire barrel, the new design of rifle not only protected the trooper whilst he was firing but it also made it more comfortable when it was strapped to his back in the manner determined by Lord Roberts.[94] However, just because the cavalry was armed with the same weapon as the infantry it did not follow that they had to accept that their traditional roles were redundant.[95] On the contrary, adopting the SMLE demonstrated that the cavalry were more than willing to embrace fire action in addition to their preferred modes of engaging with the enemy. More importantly it ensured that the cavalry would have a unique role on the battlefield. Not only could they argue that they could undertake shock action, reconnaissance and flank protection but they could also claim that their inherent mobility enabled them to play

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89 Ibid.
90 For example see evidence provided by Scots Greys, '1899-1901 Reports on Equipment in South Africa', p. 1, MOD Pattern Room Archive. For references to the accuracy of the Carbine see also: 'Extracts from Reports 1899-1901: Rifles, Carbines, Ammunition and Sword Bayonet', pp. 145-150, WO 108/272, NA.
91 James, The Life of Lord Roberts, p. 451.
92 Holmes, The Little Field Marshal - A Life of Sir John French, p. 155.
93 Report on the Organisation and Equipment of Cavalry, p. 12, WO 108/250, NA.
94 Correspondence from Secretary of State for War, Hugh Arnold-Forster to Master General of Ordnance, General James Wolfe-Murray, 7th February 1905, Arnold Forster Papers, 50315, BL.
95 Spiers, 'The British Cavalry, 1902-1914', p. 75.

a crucial role, either in the vanguard of a meeting engagement, or as an emergency stop-gap in defence.[96] Adopting the SMLE was, therefore, a shrewd move in deflecting those critics who argued that there was no place for the horse on the contemporary battlefield.

The SMLE sceptics

Whereas the views of the Indians and cavalry school were grounded in their experience of battle, what distinguishes this final group from the other factions was their sceptical views of the SMLE combined with their lack of battlefield experience. Made up of members of the NRA and doubting politicians such as Hugh Arnold Forster, the Secretary of State for War from 1903 until 1905, these actors questioned the need for a shorter barrelled rifle and were concerned by the Army's decision to abandon the LEME. As a non-governmental organisation that was closely connected to the military-political establishment, members of the NRA could use their contacts to help make a case for an alternative firearm. In combination with support from the Secretary of State for War this might have paid dividends. Surprisingly enough, however, not even the active intervention of Hugh Arnold Forster could upset a plan already set in motion by Lord Roberts. It seemed that the consensus that had formed between the Indians and the cavalry school was too strong for this last group to challenge the decision to adopt the SMLE. This section explores the difficulties that these actors experienced whilst they went about trying to challenge military opinion.

The NRA had been established in November 1859. Formed by members of the Volunteer Force, the ambition of the new association was to improve not only the shooting skills of the Volunteers but also of rifle shooters generally.[97] By holding regular competitions the hope was to make shooting as popular as other British sporting events. With the Prince Consort as Patron and the Duke of Cambridge offering an annual prize, the NRA had very close links with Royalty and the British

[96] Ibid., p.75.
[97] S. Cornfield, The Queen's Prize - The Story of the National Rifle Association, (London: Pelham Books, 1987), p. 17.

military establishment from its inception. Even today the Queen's Prize, originally established by Queen Victoria, is still a major event during the Imperial Meeting at the NRA's home in Bisley.

With the appointment of Lord Roberts to the position of Vice-President of the Association in 1901 and the eventual death of the Duke of Cambridge in 1904, the NRA was extremely unlikely to make an official criticism of the decision to adopt the SMLE. Despite its official position the membership tended to have very particular views about rifles, views which surfaced in a number of newspapers and journals.[98] Wedded to hitting conventional bull's eye targets at set distances, the association encouraged a view of marksmanship that was invariably at odds with the needs of the military.[99] As far as the NRA's membership was concerned the service rifle ought to be capable of accurately striking targets out to long range distances. Accordingly, members took a dim view of the SMLE because it did not fit with their ideas on marksmanship and rifle design. In particular they were not happy with the shortness of the rifle, the lack of a wind gauge for the rear sight and the suitability of cordite ammunition for target shooting.[100]

Similar views were being expressed by the Secretary of State for War who was unsure of the shorter rifle's merits and said as much to the Prime Minister.[101] For example, in correspondence with Sir Henry Brackenbury, the Director General of Ordnance (DGO), Arnold Forster asked for further information about the SMLE.[102] Specifically he had questions in five key areas. The first was whether the decision to adopt the SMLE was subject to trial by an independent judge. The second related to whether other nations made use of the same weapon for both their cavalry and infantry. The third was concerned with finding positive evidence that the SMLE

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[98] For an indication as to the extent to which the SMLE was subject to criticism see, 'Paper Cuttings, 1896-1905 – Small Arms and Ammunition', MOD Pattern Room Archive.
[99] For example see, 'The New Service Rifle', The Times, 15th September 1903.
[100] Ibid.
[101] Arnold Forster Papers, 50315, BL.
[102] The New Rifle – Memorandum by the Secretary of State for War and Replies by Sir Henry Brackenbury, Director General of Ordnance,' 29th April 1903, Arnold Forster Papers, 50315, BL.

was better than the rifles of other nations. The fourth centred on how shortening the rifle by four inches affected the range of the SMLE when compared to the long LEME and the firearms of other nations. In his final question Arnold Forster asked whether longer ranges were no longer deemed necessary by the Army.

Given that the Secretary of State would have to defend the Army's decision in the House of Commons it might not appear that Arnold Forster was doing anything other than trying to make sure that he was sufficiently briefed. However, even after he had received an official response from the DGO outlining the main arguments in favour of the SMLE, the Secretary of State did not appear to be happy with the situation.[103] In 1905, for instance, after Brackenbury had been replaced by General Wolfe Murray, at that time Master General of Ordnance, Arnold Forster asked similar questions once more. This time, however, the responses he elicited were not just the views of the MGO but also those of the Superintendent of the RSAF who re-emphasised the points being made by Wolfe Murray.

Clearly the Army was singularly unimpressed by the critics and was not prepared to compromise on the SMLE. In a review of the arguments being made by the Bisley set, Major Markur re-stated for the benefit of the Secretary of State the facts of the battlefield as understood by the Army.[104] Fighting on the North West Frontier and in South Africa had demonstrated the need for a light, handy rifle that would be more than sufficient for the average infantryman. There was no need for a match rifle, '...for the use of experts contesting across the green expanses of Bisley... [but instead a weapon]... for use by comparatively clumsy practitioners, whose operations extends from Canada to the Cape, and from the Afghan frontier to Singapore...'.[105] Evidently the military members of the War Office, having returned from the war in South Africa, were not prepared to take lessons in rifle design from people who had not experienced the contemporary battlefield.

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[103] Ibid.
[104] Major R. J. Makur, 'New Short Rifle – Summary of Leading Facts', Arnold Forster Papers, 50215, BL.
[105] Ibid.

On the face of it these issues do not appear to say much about why the SMLE took the form that it did. However, it could also be argued that the SMLE sceptics' failure to make any changes to the way in which both battlefield problems and its technical solutions were perceived says much about the relative power of the Army compared to politicians, the press and other non-governmental actors at that time. Certain members of the NRA had a particular view of the battlefield skewed by their interest in target shooting. This resulted in a reasonable amount of press coverage, stimulating parliamentary questions and some consternation with the Secretary of State for War.[106] However, in the aftermath of the Boer War it was difficult for the critics to get their voice heard or to challenge the decision already made by the Indians and cavalry school. Consequently, the views of this final group could be marginalised by the strength of opinion within the Army, committed as it was to a handier, lighter weapon with increased rates of fire. What is more surprising is how the Secretary of State was unable to challenge the Army's decision with regards to the SMLE even though he had support from outside the War Office. Reliant as he was on the advice given him by the Army itself, it was extremely hard for a politician to dispute the choices of the Army.

Conclusion

At first glance the SMLE looks like it is simply concerned with improving the initial design of the LEME. According to this line of reasoning, the SMLE represents the onward march of technical progress towards ever more destructive types of weaponry where fire action would dominate the future battlefield. Where this interpretation falls down, however, is in relation to the contingent nature of events that shaped the SMLE's development. Without the collapse of the Wolseley ring, for example, it is considerably more likely that the suggestions made by Hamilton's rifle committee would have been rejected by a sceptical Commander-in-Chief. As it was, the ideas proposed by the committee received a warm reception from Lord

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[106] House of Lords debate, 23rd February 1905, Parliamentary Debates 4th Series, Vol. 141, columns 1019-1071.

Roberts, a man who was well disposed to Hamilton and held similar views with regards to firepower and tactics.

The SMLE was, therefore, a weapon that reflected the views of this newly dominant group of former Indian Army officers. Shaped as they were by their experiences on the North West Frontier, as far as Hamilton and Roberts were concerned it was important to adopt firearms with increased rates of fire and to find ways to encourage soldiers to use their rifles according to the demands of battle. The way in which this view manifested itself in the design of the SMLE related to removing those technical contrivances that hindered rapid fire. This meant designing a lighter and shorter rifle, thereby making it easier to bring it to the shoulder for snap firing at moving targets. At the same time, if the enemy were unwilling to reveal their positions or were moving quickly, then faster reload times would make up for the increased chance of missing the target. Consequently, the SMLE gave troops the ability to generate fire more quickly and at a pace appropriate for a particular engagement.

The collapse of the Wolseley ring did not, however, guarantee the cooperation of either the cavalry school or the SMLE sceptics. Given the post-Boer War relationship between the Indians and the cavalry school, for example, the possibility that consensus might have emerged with regards to what ought to replace the LEME seems unlikely. After all there was every possibility that mutual distrust could prevent agreement from being reached on the SMLE. What becomes clear, however, is that the two groups could find common cause in the rifle question precisely because it did not compel one side to accept the battlefield tactics of its rival. Thus the Indians might have been interested in increasing the rate of fire a soldier could generate but the cavalry were more concerned with demonstrating their continuing relevance to warfare. In this respect the decision by the cavalry to accept a weapon used by the infantry was a way of maintaining their unique role on the battlefield. For both groups then, the SMLE was acceptable because it left open the tactical possibilities.

Finally, the NRA and the sceptical politicians are an interesting aside to this story primarily because of their inability to affect the procurement process. Outside of government the SMLE's critics could only manage to voice their opinions through the press. This might have helped a Secretary of State who had concerns about the replacement for the LEME. Inside the War Office, however, the ability of Hugh Arnold Forster, the Secretary of State for War, was equally circumscribed. Dependent on information provided by his military advisors it was not possible, despite some concerns about the appropriateness of the SMLE, for the government to challenge the Army on its decision to replace the LEME. No doubt what buttressed the Army's endeavours in this regard was the knowledge that sooner or later a new minister would come to power and their interests in the new rifle would not necessarily be the same as those of Arnold Forster. At the same time, the language used by the Army to define the tactical problem they faced could not easily be redefined by non-experts. As a result, the sceptics were increasingly locked into a form of debate that made it hard to escape the views of the Indians and the cavalry. When it came to technical matters the Army was the dominant actor whilst politicians were insufficiently powerful to affect design choices.

Chapter Four - The Experimental Model 2 (EM2)

EM2 advocates

In April 1951 the Secretary of State for Defence, Emmanuel Shinwell, announced that the British Army would replace the SMLE and the No.4 Rifle with the Experimental Model Two (EM2).[1] This new weapon, named the Rifle No.9 Mk.I, represented a radical break with previous policy on small arms.[2] If the LEME was about fire control and the SMLE with increasing the rate of aimed fire then, as will become clear, the EM2 was the first British Army rifle expressly created to provide tactical flexibility. Issued to every soldier and designed to function as both a self-loading rifle and a machine carbine, the EM2 would have provided the infantry with a weapon capable of generating higher volumes of fire.[3] Troops that had previously been dependent on suppressing fire from the Bren Light Machine Gun (LMG) or the Vickers Medium Machine Gun (MMG) would have, organic to their own section, sufficient firepower to enable them to keep the enemy's heads down whilst manoeuvring to their objectives. Consequently, the men could fight their way forward without having to wait for the LMG or MMG to be set up. Once on the enemy positions, the EM2 could be used like a machine carbine for close quarter engagements. Combat could as a result evolve at a higher tempo, unconstrained by the technology at the disposal of infantrymen previously. The EM2, it seemed, held out the prospect of reaching the 'ideal' technical solution to the problems of the battlefield.

Developing the "ideal" solution did not, however, result in its selection. For by 1957 the decision to equip the infantry with one weapon that could perform as both a self-loading rifle and a machine carbine had been abandoned in favour of two weapons, each designed for a specific purpose. *Fabrique Nationale's Fusil*

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[1] Issued to troops during the Second World War, the No.4 Rifle was effectively an updated version of the SMLE but designed for mass production. For Shinwell's announcement see Parliamentary Debates (Hansard), House of Commons, Oral Answers, 25th April 1951, column 378.

[2] See List of Changes LC. C9647, MOD Pattern Room Archive.

[3] A machine carbine in contemporary terms would be called a sub-machine gun.

Automatique Léger (FAL) would function as a self-loading rifle, used to engage targets at range and be given to those troops who had previously been armed with an SMLE or No.4 Rifle. At the same time the Sterling L2A1 would supersede the Sten machine carbine, be used for close quarter fighting and be given to officers and NCOs.[4] On the face of it this change did not appear to diminish the Army's technical capabilities but as this case study shows the tactical flexibility made possible by the EM2 was lost as men armed for specific battlefield tasks had to plan to be at the right place at the right time. If the transition from single shot to automatic weapon was in some way an inevitable culminating point in a whiggish account of technical change in small arms then why would the Army agree to impose limitations on its weaponry and way of fighting? What had produced a change in attitudes between 1951 and 1957?

In many ways, the answer to this question might appear to be simple. As this case study shows, a change in government brought to power politicians who were hostile to the weapon and prepared to reverse the previous decisions to adopt it. Yet underneath this bald statement of fact there were many groups of people who, over a decade, came together to define, organise, develop and agree on a technical response to a particular battlefield problem. This required a careful balance of arguments that ultimately crystallised in the form of the EM2. With the defeat of the Labour Party in October 1951, the contentions made during the previous parliaments did not suddenly lose their validity. Rather, the various groups had to re-negotiate until a new equilibrium could be struck, making agreement and subsequent technical change feasible. From the point of view of the actors themselves, the result bore little relationship to what they conceived of as the best possible outcome. It did, however, represent the kind of solution that, given the constraints on the various organisations involved, all parties could live with.

[4] See List of Changes LC. C8288 EA. W/321 and LC. C8387, EA. W/151, MOD Pattern Room Archive.

Bearing all this in mind, it ought to be noted that the EM2 story is more complex than that of the LEME and SMLE. This is partly because there are considerably more actors but it is also clear from the evidence that the types of arguments advanced were founded on increasingly sophisticated forms of analysis. Data collection techniques from the field had become more systematic and this had an effect on how proposals were framed. Scientific methodology was more rigorously applied to the evidence, arbitrating between and helping to justify the technical choices being made. Certainly, attitudes towards fire control, logistics and the infantryman had changed since the decision to adopt the SMLE but so had the relevant social groups.

Given its complexity and in order to make the EM2 story more easily digestible this narrative is therefore split into three parts. This chapter identifies and explores the views of the various British actors who had an interest in developing automatic weapons for the infantry. Three different factions had to be brought together in order to construct and promulgate a sufficiently authoritative argument in favour of the EM2. The groups concerned stretched from the War Office to the Ministry of Supply and included a number of Directors of Infantry, the Armament Design Establishment and both the Director of Artillery and the Director of Artillery (Small Arms). With engineers, scientists and soldiers all working on the Infantry Personal Weapon (IPW) programme, of which the EM2 formed a part, extra effort was needed to translate the needs of each group into terms that everyone could understand. All this involved considerable exertion over a long period of time reflecting the point that the EM2 advocates, as these actors are described here, interpreted the IPW differently.

Chapter five shows that, despite the quantity of Second World War evidence produced by those interested in adopting the Rifle No.9 Mk.I, the decision to switch to a weapon with high rates of fire was far from inevitable. This part of the case study is therefore concerned with identifying the EM2 sceptics within the War Office and establishing their views on the IPW programme. Wedded to a particular view of marksmanship associated with the development of the SMLE, these men believed that automatic firearms would encourage troops to engage with the enemy without deliberately aiming. Not only would a soldier's accurate shooting skills decline but the demand on the supply chain would compromise the ability of the logisticians to keep up with the increased usage of ammunition. If these actors were to be brought on board then their concerns would have to be addressed through a careful balance of arguments and technical choices. However, given that the EM2 advocates supplied the data which fed decision making, it was always going to be extremely difficult for the sceptics to reach justifiable alternative conclusions without falling back on personal experience or hearsay. Accordingly, the logic underpinning the selection of the EM2 was, whilst open to challenge, still difficult to unwind.

The EM2 advocates' ability to take advantage of certain solutions was further limited by the involvement of allies who had an interest in ensuring that Britain adopted certain standardised equipment. Chapter six is therefore about exploring the views of this wider network of relevant social groups who were opposed to and consequently unravelled the balance of arguments for the EM2. In this final part of the story the needs of the British infantry were weighed against the military, bureaucratic and political concerns of Winston Churchill and the American, Canadian and French Governments. Consequently, the technical solution arrived at between the War Office, Ministry of Supply and the previous Labour Government was placed in a completely new light. The arguments of this wider network of protagonists interpreted the British solution differently and, in effect, re-defined the problem. With a different frame of reference the technical balance achieved in the EM2 was systematically undermined on a variety of grounds based on the interests and commitments of this new set of actors. In particular, as the Americans were not reliant on British data, they could more easily interpret the nature of battle differently. For them bullet stopping-power and marksmanship was key. Thus a central plank in the argument against the EM2 was related to the wounding power of its ammunition at certain defined ranges. Bearing in mind that British and American scientists had fundamentally different ways of describing wounding power, this chapter explores the underlying science with a view to showing how the EM2 was capable of several interpretations even at this scientific level. As the final *coup de grâce* came from the Belgian company *Fabrique Nationale d'Armes de Guerre* (FN) the last section of this final chapter examines the pivotal role that the company played in undermining the British small arms community. Specific reference is paid to identifying the successful strategies FN utilised in order to pick up the order for the new Infantry Personal Weapon.

Before proceeding, however, it is important to describe some of the technical features of EM2 so that it is clear how it differed from more conventional rifles. There were five key characteristics which set the EM2 apart from its rivals. Firstly, the weapon was designed to fire a new calibre of rimless ammunition called the .280 inch. This specification was radical in that, for the first time in British military history, the research establishment responsible for the ammunition had gone back to first principles and based its decisions on a methodology derived from physics. Secondly, the EM2 had an eye-catching unconventional layout. Its bullpup configuration made the weapon shorter than a typical rifle but it still retained many of the same qualities. The absence of a butt meant that the trigger mechanism housing had to move forward of the magazine. As a result the EM2 was handier and lighter than both the British No 4 Rifle and the American M1 Garand. Thirdly, an optical unit sight came as an integral feature of the EM2. Because the weapon did not have a stock it was not easy for the user to bend their head over the barrel making it difficult to aim. To get around this problem a carry handle was provided at the point of balance along the rifle's length upon which the optical sight was placed. Fourthly, the EM2 was capable of fully selective fire: it could be used in single shot or continuous, automatic fire modes. Finally, the EM2 was intended as a magazine-fed weapon. No charger clip was provided as the magazines would be pre-loaded. Accordingly, once a full magazine had been discharged it was discarded and replaced by a new one.

The Director of Infantry

The position of DInf was created in the spring of 1943 and was responsible for administering the equipment and manpower needs of the infantry. For the first time in the British Army's history there was a senior officer solely interested in, '...giving the infantry a voice on a par with the other teeth arms'.[5] As a part of the Office of the Deputy Chief of the Imperial General Staff (DCIGS), then commanded by Lieutenant-General Ronald Weeks, the DInf was part of a wider effort to ensure that Britain's armies in the field had the appropriate means to defeat the Axis powers.[6] When it came to small arms, the views of the seven consecutive Directors of Infantry (DInf) involved in piloting the EM2 from idea to adoption were in many ways similar.[7] That said, it was Major-General Wilson, the first DInf, who did the most to set the tone of post-war decision making on rifle selection. Wilson not only put in place the mechanisms by which the technical requirements of the infantry could be systematically identified but he also took steps to address the infantry's need for greater battlefield flexibility. Tactics associated with fire and movement provided the basis for this flexibility but the technique would only work if infantrymen had firearms capable of generating sufficient quantities of fire to suppress the enemy. At the same time, movement was hindered by the weight of the weapons and ammunition soldiers were forced to carry as they were advancing to their objectives. Existing equipment did provide troops with the means by which they could engage with the enemy but the question was whether, given battlefield conditions, new lighter firearms with increased rates of fire might be more appropriate. Unfortunately for the DInf, identification of the problem was not automatically accompanied by the power to design and implement a solution. This next section is therefore focused on identifying not only the reasons that inspired the

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[5] French, Raising Churchill's Army: the British Army and the War Against Germany, 1919-1945, p.71.

[6] R. Weeks, Organisation & Equipment for War, (Cambridge: University Press, 1950), pp. 31-32. Before becoming the DCIGS, Lieutenant-General Weeks was an industrialist.

[7] The seven DInfs involved in the EM2 project were: 1943-1946 – Major-General TNF Wilson; 1944-1946 – Major-General DN Wimberley; 1947-1948 – Major-General AB Dowler; 1948-1949 – Major-General Fairbanks; 1949-1952 – Lt-General CM Barber, who was both DInf and Director of Military Training; 1952 – Major-General JHO Wilsey;1952-1955 – Major-General FRG Matthews.

desire to adopt an automatic weapon but also how Wilson went about creating the conditions by which he could put his ideas into practice.

The first officer to be appointed DInf was Major-General T.N.F. Wilson.[8] Wilson was a Staff College graduate and First World War veteran. As commander of 3rd Brigade in Alexander's 1st Division in France during the fighting in 1940 he had been awarded a bar to his DSO following Dunkirk. However, it was his 1942 appointment to be commandant of the School of Infantry and his subsequent move to become the first DInf in 1943 that established his importance to the EM2 story. In the first half of the war, the School of Infantry had worked hard to increase the technical competence of the citizen soldiers that now made up the bulk of the infantry. The central question that interested Wilson, once he had become DInf, was related to whether the infantry could, or should, be equipped with a firearm that might make it easier for these newly conscripted troops to take advantage of their training.[9]

The School of Infantry had been born out of the Battle School movement. These schools not only trained soldiers in how to deal with the battlefield environment but were also instrumental in raising morale. The first of the Battle Schools had appeared in the summer of 1941 and was attached to 47th Division in Southern Command.[10] Other Army training institutions were already in existence but, whilst outstanding, they were unable to cope with the demand produced by the rapid increase in wartime infantry numbers.[11] Unsanctioned by the War Office and under the inspirational leadership of Lionel Wigram, a Territorial Officer and former lawyer, the 47th Division Battle School filled a gap in the training regime which soon came to the attention of Southern Command's General Officer Commanding, General Sir Bernard Paget. Impressed by the approach Paget quickly moved to

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[8] There were a number of Major-General Wilsons during the war. The Wilson referenced here is Thomas Needham Furnival Wilson CB, DSO, MC.
[9] Wimberley Papers, PP/MCR/182 Imperial War Museum (IWM).
[10] T. H. Place, 'Lionel Wigram, Battle Drill and the British Army in the Second World War', War in History, Vol: 7, No: 4 (2000), p. 442.
[11] Ibid., p. 446.

expand the 47th Division's efforts by establishing an infantry-wide School of Battle Drill at Barnard Castle, County Durham, in early 1942 after his appointment to command all Home Forces.[12] Wigram was subsequently appointed the chief instructor for this new establishment and was given the task of training additional instructors for divisional schools that were then being formed around the country. By the summer of 1942, Battle Schools had become so pervasive that the War Office decided to formalise the movement, renaming it the School of Infantry.[13]

The central technique taught by the Battle Schools was a series of tactical drills.[14] The objective of these was to explain to junior officers and NCOs the basics of fire and movement, the main tenets of which were to manoeuvre in front of the enemy only when they were being suppressed by infantry fire, or fire organic to the battalion.[15] Thus if two infantry sections were to mount an attack on a defended position then one would be used to fire on the enemy whilst the other moved forward, taking advantage of ground and cover, to attack a flank. This practice known as 'keeping one leg on the ground', was designed to stop opposition troops returning fire on the manoeuvring section.[16] If used properly the technique had the potential to allow the infantry to find an advantageous position from which they could engage and then advance or outflank and eventually kill their foe.

The training provided the infantry with standard drills which they could fall back on when unclear about how to proceed. However, the system also imposed considerable demands on the soldiers themselves. Clearly, all concerned had to be sufficiently trained in the various techniques so that they understood, before an engagement began, how they would go about overwhelming the opposition. But there were also a number of additional factors that might limit the effectiveness of

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[12] Ibid., pp. 446-447.
[13] Ibid., p. 456.
[14] Ibid., p. 444.
[15] For more information about the techniques and tactics being taught at the schools see L. Wigram, (Infantry) Battle School (1941): a Detailed Description of the Evolution of Battle Drill Training in its Early Stages, (Cambridge: John Bodsworth, 2005).
[16] Ibid., p. 160.

the approach. Firstly soldiers had to be very fit so that they could carry at least a 9lb rifle or a 22lb Light Machine Gun, plus large quantities of ammunition, to a position on the battlefield from where they could engage with the enemy.[17] And, secondly, they needed weapons with a considerable weight of fire if they were to stand a chance of either suppressing or killing their opponent.[18]

As the commandant of the Battle Schools, Wilson had recognised the importance of Wigram's efforts and been quickly converted to its pedagogical programme.[19] However, even though the schools had pointed to the central problem facing the infantry, in 1943 the DInf was new to the General Staff and therefore his ability to bring about changes in organisation or equipment was untested and consequently uncertain. Opposition to any proposals might come from two directions. The first and most serious came from forces in the field. By longstanding convention, unit commanders were free to organise and train their men dependent on the conditions that they faced.[20] Accordingly the DInf could not force his recommendations on to unwilling formations. The second but more manageable source of friction came from more senior officers at the War Office who could prevent change if they were not convinced by the DInf's arguments.

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[17] I. V. Hogg, Jane's Guns Recognition Guide, (Glasgow: HarperCollins, 2002).

[18] This issue had been considered previously. Major McMahon, a Chief Instructor at the School of Musketry in the years before the First World War had shown by practical experiment that 150 second rate shots firing the SMLE rapidly could inflict more damage on an enemy moving in groups and by bounds than 100 elite marksmen. However, for a variety of reasons the General Staff had decided not to accept McMahon's conclusions and the issue was buried. Consequently, the notion that more lead in the air might improve the probability of achieving a kill had languished and it was only after the Second World War that this "chance to kill" phenomenon was described as a statistical formula. Indeed as a result of work by the US Operations Research Office (ORO) attached to Johns Hopkins University, and whose membership included the esteemed SLA Marshall, that this started to be discussed more openly. According to the ORO the equation to describe the probability of killing a target involved multiplying the probability of achieving a hit by the probability that the round might strike a part of the victim's body that contained a vital organ. For information on Major McMahon see S. Bidwell and D. Graham, Fire-Power: British Army Weapons and Theories of War 1904-1945, (London: George Allen & Unwin, 1982), p. 29-30. For the original material see also Bruce Williams Papers, 77/189/93, IWM. For references to the ORO see E. Prokosch, The Technology of Killing: a Military and Political History of Anti-personnel Weapons, (London: Zed Books, 1995), p. 42.

[19] T. H. Place, Military Training in the British Army, 1940-1944: from Dunkirk to D-Day, (London: Frank Cass, 2000), pp. 60-61.

[20] French, Raising Churchill's Army: the British Army and the War Against Germany, 1919-1945, p. 22.

From the beginning, Wilson clearly understood that if he were to do anything about influencing Army policy then he would need a bureaucratic device that could propose solutions that were based on the considered views of the British small arms community. This meant bringing together those responsible for training and equipment development and ensuring that their views were grounded in battlefield experience, preferably by relating it to data from the field. Potentially this would give the DInf a powerful basis for challenging the received opinions of certain members of the General Staff by legitimising the views of military and technical experts alike. At the same time, his recommendations would carry more weight with those field formations unwilling to adopt new modes of equipment or organisation.

One of the first achievements of the new DInf was, therefore, to convince the DCIGS that a committee dedicated purely to the development of infantry weapons was required. This Standing Committee on Infantry Weapon Development which first met in May 1943 included representatives of: the Director of Military Training, Director of Military Intelligence, School of Infantry, Small Arms School, the Dominions, field formations and Home Forces, Ordnance Board and the Director of Artillery (Small Arms), the Assistant Chief of Armament Design, and Weapons Technical Staff from the Ministry of Supply. The Committee's terms of reference were broad and included not only ensuring that, '...our Infantry weapons are superior in every way to those of any potential enemy...' but also to, '...forecast our own Infantry tactics in relation to the enemy's in order to assess the battle conditions under which weapons may be required'.[21]

Within six months the Committee adopted a resolution calling for a better quality of weapon for the infantryman.[22] Previously, it had been necessary to produce as many firearms as possible so that the Army would have enough to prosecute the war

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[21] Memo circulated by DInf on the Objectives of the Standing Committee, 30th May 1943, 120 Meetings – Conferences (Future Design of Weapons) – Box 2, MOD Pattern Room Archive.
[22] Meeting of the Standing Committee on Infantry Weapon Development, 1st September 1943, 120 Meetings Conferences (Future Design of Weapons) Box 2, MOD Pattern Room Archive.

against the Axis powers.[23] As a result field formations had been compelled to fight with a variety of equipment that was sometimes of poor design but more usually the result of failed quality assurance at the manufactory.[24] With the appointment of the DInf it was felt that, 'The Infantry above all arms and services have a right to expect the best in design, materials and workmanship because their casualties on the battlefield are higher than those of any other service'.[25] The aim was clearly to try to restore the confidence of the soldier who for much of the war had been compelled to use substandard or very old equipment.

By the summer of 1943, with some insights provided by the Battle Schools and a bureaucratic device for challenging received opinion at the War Office, Wilson was in a position to change the make-up of weaponry at the section level. Systematic surveying of units in the field was being made available to the DInf's committee revealing what equipment worked well under various organisational and climatic conditions.[26] At the same time operational researchers attached to the School of Infantry had examined the battlefield data coming from after-action reviews.[27] What

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[23] For example, 1938 production of Bren guns amounted to 300 per week rising to 400 per week in September 1939. Before Dunkirk, the BEF had around 40,000 Bren guns. Following the retreat from France the Army in Britain possessed only around 2,500 weapons. By 1942 production reached 1000 weapons per week. At the beginning of the war, however, production was centred at the RSAF at Enfield Lock. This was subject to regular air raids which could severely disrupt output. By September 1939 production standards it would take around two years to replace all the lost Bren guns following the Dunkirk debacle. See A. J. R. Cormack, Famous Rifles and Machine Guns, (London: Barrie and Jenkins, 1977) p. 27.

[24] For example 237,732 Sten Mk.Is and Mk.IIs (or 16% of entire Sten output) were recalled because of quality assurance problems. This fundamentally affected the confidence of troops in their equipment despite revisions that significantly improved the weapon's reliability, see P. Laidler, The Sten Machine Carbine, (Cobourg, Ont.: Collector Grade Publications, 2000), pp. 299-302. For the views of the service men issued with early production versions of the No.4 Rifle see 'Summary and Consolidated Report by WTSFF on Infantry Questionnaire and Answers from Units in First and Eighth Armies on Conclusion of N. African Campaign May 1943', 200 Small Arms General Box 1. For evidence of early quality assurance failures see Memorandum from DOS to DDOS, Rifles No.4 Mk.I* - British Manufacture, 8th December 1942, 200 (200) Small Arms General Box 2, all found in the MOD Pattern Room Archive.

[25] Meeting of the Standing Committee on Infantry Weapon Development, 1st September 1943.

[26] For example, see 'Summary and Consolidated Report by WTSFF on Infantry Questionnaire and Answers from Units in First and Eighth Armies on Conclusion of N. African Campaign May 1943'.

[27] This data came from 'Current Reports from Overseas' (CRO) and 'Notes from Theatres of War' (NTW). Both the NTW and the CRO documented combat experience and lessons learnt. NTW was officially sanctioned, had been edited by the War Office and endorsed by the relevant HQ. CRO provided a vehicle for transmitting combat lessons where War Office and Army level approval had not yet been achieved. A detailed description of both types of document can be found in Place,

both sources of evidence indicated to the DInf and the Committee on Infantry Weapon Development was the need for reliable, lighter weapons with increased rates of fire especially at the point of the final assault.[28]

This was reflected in analysis undertaken by operational researchers investigating the distribution of equipment within the existing infantry section. What this examination suggested was that more fire could be generated if a greater proportion of the section was armed with the Sten machine carbine.[29] At the start of the war, the typical British eight man infantry section carried seven rifles and one Bren LMG.[30] The well-trained rifleman armed with a No.4 could, in the right circumstances, fire 15 shots per minute.[31] The Bren gun was magazine-fed and typically loaded with 28 rimmed .303" cartridges.[32] Manned by two men and if the bipod was being used, it could theoretically fire between 450 and 550 rounds per minute.[33] In practice, however, fire was often limited by the number of replacement barrels available and the amount of ammunition the rest of the infantry section could carry. Indeed, as one infantry commander observed, 'In attack, the Rifleman seldom

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Military Training in the British Army, 1940-1944: from Dunkirk to D-Day, pp. 12-15. For an excellent introduction to the work of the Army Operational Research Group see T. Copp, Montgomery's Scientists: Operational Research in Northwest Europe: The Work of No.2 Operational Research Section with 21 Army Group June 1944 to July 1945, (Waterloo, Ont.: Wilfrid Laurier University, 2000). For a good introduction to the operational research undertaken in Britain during the Second World War see J. F. McCloskey, 'British Operational Research in World War 2', Operations Research, Vol: 35, No: 3 (1987) and M. W. Kirby, Operational Research in War and Peace - The British Experience from the 1930s to 1970, (London: Imperial College Press, 2003).

[28] See, AORG memoranda 'Infantry Battle', Shephard Papers Box 2 - File 00028, Laurier Centre for Military, Strategic and Disarmament Studies (LCMSDS) and 'The Fire-Power of the Infantry Section', Shephard Papers Box 2 - File 00028, LCMSDS.

[29] Ibid.

[30] By 1944, the section had increased in size to ten men. Typically the officer and NCO were armed with Sten guns, seven others had rifles and one man had a Bren gun. For an organisation chart of the 1944 infantry battalion see, G. Forty, British Army Handbook, 1939-1945, (London: Chancellor, 2000), p. 165.

[31] French, Raising Churchill's Army: the British Army and the War Against Germany, 1919-1945, p. 84.

[32] The magazine could contain 30 rounds. However, troops often only loaded 28 rounds into the magazine in order to prevent feeding problems.

[33] 450 to 550 rpm quoted from J. A. Barlow, Small Arms Manual, (London: J. Murray, 1942). It was stated at a meeting of the infantry Weapons Development Committee that fire on average was 74 rounds per minute. See Meeting of the Infantry Weapons Development Committee, 24th February 1944, Conferences (Future Design of Weapons) Box 2, MOD Pattern Room Archive.

uses his rifle, being mostly employed as an ammunition carrier for the Bren'.[34] The Bren had a tripod attachment that could be used for sustained fire and to increase the accuracy of the weapon but it was rarely found in the forward battlefield areas.[35] Therefore, depending on the quality of the men and the amount of ammunition carried by the section, nearly half of the firepower could be generated from just the Bren gun team.[36]

In terms of fire and movement, this usually meant that the Bren was more useful when sited in such a place as to provide covering fire for the rest of the section advancing to attack the enemy.[37] According to Major-General Wilson the overall tactical objective was to ensure that, '...all the available infantry weapons... [were] brought to bear upon the enemy, not only in the initial stage of the advance, but also up to the last possible moment so that the infantry can literally be shot into close quarters'.[38] Bearing in mind the difficulties associated with ensuring troops reached the battle in an order appropriate for this type of engagement, research indicated that this tactic was unlikely to happen in practice or for men to ignore battle drill

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[34] See 'Points Raised by Delegates, Infantry Training Conference', 23rd April 1944, WO 204/1895, NA.

[35] Indeed as much as anything this attachment led some in the small arms community to spuriously compare it with the German general purpose machineguns (GPMG), the MG34/MG42. See 'Infantry Notes No.6 – Appendix A, "Spandau versus the Bren"', 17th September 1944, WO 205/998, NA. For a more balanced comparison of the respective qualities of the Bren versus the belt fed German GPMGs, see also 'Rate of Fire of LMG', WO 291/474, NA.

[36] By contrast the typical German infantry section contained 13 men armed with a combination of bolt action rifles, machine carbines and MG34. The MG34 was an air cooled, belt-fed weapon which had a theoretical rate of fire of between 800 and 950 rounds per minute (rpm). Its successor, the MG42 had an even higher theoretical rate of fire at between 1100 and 1150 rpm. In actual operations these weapons would produce significantly less firepower, from 150 to 300 rpm for the MG34 and from 150 to 450 rpm for the MG42, reflecting the difficulty of getting sufficient ammunition and replacement barrels in the same place at the same time. However, what was clear was that the MG34 and its successor, without the contribution of any other weapon, produced rates of fire that made the German infantry section considerably more potent than its British equivalent. See French, Raising Churchill's Army: the British Army and the War Against Germany, 1919-1945, p.39 and 'Notes prepared by M.I.10 on German LMGs and MMGs and their Tactical Use', 22nd July 1943, 120 Meetings – Conferences (Future Weapons Design) Box 2, MOD Pattern Room Archive.

[37] Nearly all of the drills taught by the Battle Schools were underpinned by this technique, see Wigram, (Infantry) Battle School (1941): a Detailed Description of the Evolution of Battle Drill Training in its Early Stages.

[38] T. N. F Wilson, 'The Role of the Infantry', JRUSI, Vol: 89 (1944), p. 2.

entirely.[39] A more common occurrence might be for several sections to mount an attack with two or more Bren guns providing cover for the rest of the riflemen.[40] In either case, however, the ability of the infantry to fire and move according to the needs of the battle was restricted in part by the way in which men were armed with different types of weaponry.[41] The Bren being heavier was more suitable for firing from a fixed position. The rifle was more mobile but had an insufficient rate of fire at close quarters. Ideally a solution would be found that gave troops a weapon that had the firepower advantage of the Bren and the weight advantage of the rifle.[42]

The answer according to the operational researchers was to change the distribution of weaponry within the section such that more men were armed with the Sten gun.[43] There were several reasons underpinning this suggestion. Firstly, lighter Sten guns were more useful to troops on the attack where battlefield tempo demanded that a soldier had to move quickly and stop rarely to take deliberate aim at an

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[39] For an account of how men behaved in battle read Lionel Wigram's own analysis in the appendix of D. Forman, To Reason Why, (London: Abacus, 1993), pp. 199-201. This point is further developed by Ian Gooderson who writes that such problems were familiar to both US and British infantrymen throughout the Italian campaign. See I. Gooderson, A Hard Way to Make a War: The Italian Campaign in the Second World War, (London: Anova, 2008), pp. 126-141 and pp. 296-309.

[40] Forman, To Reason Why, pp. 200-201.

[41] This is implicitly stated by Wilson when he wrote that the infantry, '...must at all times be able to fight their way forward and to close with the enemy with the support of their own weapons. It is to this end that the modern organisation and fire power of the infantry is designed. In this organization the balance must be held between fire power, assault power and manoeuvrability'. See Wilson, 'The Role of the Infantry', p. 2.

[42] By 1945 it was being stated explicitly by Weapons Technical Staff attached to 21st Army Group that, 'The reduction in weight that could be affected in the re-design of Infantry weapons, together with the simplification of ammunition carriage and supply, would over-ride the advantage of being able to engage the enemy at longer ranges on the relatively few occasions when such opportunities arise'. See, 'Final Report of Small Arms Effectiveness for Western Campaign WW2 from D-Day to VE Day - Small Arms Section from Weapons Technical Staff at 21st Army Group'. 15th July 1945, MOD Pattern Room Archive, 121 Design of Weapons - Box 3.

[43] The Sten has been wrongly singled out for being unreliable. These problems were at least initially down to poor manufacture rather than an inherent weakness in the design. Despite significant later improvements in its manufacture and design, the initial problems with the Sten left the infantry cautious about the weapon's reliability for the remainder of the war, for an example of this see S. E. Ambrose, Pegasus Bridge D-Day: the Daring British Airborne Raid, (London: Pocket, 2003), p. 169 and p. 181. See also note 24 above. Although it is not clear which version of the Sten was at fault, it should be noted that complaints about the weapon were still being recorded by Canadian infantry fighting in the Korean War. See, B. Watson, Far Eastern Tour: the experiences of the Canadian Infantry in Korea, 1950-53, (PhD, University of Victoria, Victoria, British Columbia, 1999), pp. 118-120.

inconspicuous enemy.[44] The machine carbine was a weapon designed for close quarter combat but research showed that at ranges of up to 200 yards its high rate of fire gave the man using it a higher chance of hitting his target than if he was armed with a rifle.[45] Secondly, theoretically capable of firing in the region of 500 rounds per minute and with a total weight of under 7lbs (depending on version) the Sten was considered to have as much value as the Bren LMG at ranges up to 300 yards. Finally, because of the small size of its ammunition, arming most men in the section with a Sten gun did not present any logistical issues: with a weight equivalent to a rifle and 50 rounds, the man armed with a Sten could carry up to 128 rounds.[46] Bearing in mind that artillery support was usually made available, the infantry could often advance to within assaulting range of the enemy (100 yards distance) without need of their own long range battalion weapons.[47] MMGs and LMGs would still be necessary in defence and for helping troops manoeuvre but the weight of evidence suggested that more advantage would be gained from exchanging the No.4 Rifle for the Sten. Where specialist skills permitted, one man might usefully be equipped with a sniper rifle, but otherwise the section could be turned over to weapons with higher rates of fire.[48] According to the operational researchers the Sten could provide the tactical flexibility required by the infantry.

Unfortunately for the DInf, it was not clear whether he might be able to persuade his War Office colleagues as to the efficacy of any of these ideas. Opposition to Wilson's proposals to change the equipment and organisation of the infantry battalion came early in his time as DInf. For example, in July 1943, following a trip

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[44] At an infantry training conference in April 1944, one delegate observed, 'It is considered that present teaching lays too much stress on the use of infantry weapons in the attack, especially the Bren. Experience shows that the ammunition problem is acute in the counter attack phase. Ammunition fired in the attack is seldom aimed and therefore wasted'. See 'Points Raised by Delegates, Infantry Training Conference', 23rd April 1944, WO 204/1895, NA. The AORG also demonstrated that the Sten would be very effective when fighting in built up areas or at night. See AORG memoranda 'The Fire-Power of the Infantry Section', Shephard Papers Box 2 - File 00028, LCMSDS.

[45] Ibid., see also AORG Memo 125, Interim report on performance of bullet weapons, WO 291/473, NA.

[46] See 'The Fire-Power of the Infantry Section'.

[47] See 'Infantry Battle'.

[48] See 'The Fire-Power of the Infantry Section'.

to First Army in the Middle East, Wilson gave the Standing Committee on Infantry Weapon Development the opportunity to discuss whether the Vickers MMG ought to be a battalion, brigade or divisional weapon.[49] Having come to the conclusion that there was a sufficient supply of these weapons available for issue to battalions, the DInf took his recommendations to the DCIGS. At this meeting Wilson accepted the convention that commanding generals ought to decide how to deploy their forces but pointed out that battalion commanders had wanted the Vickers as part of their resource pool.[50] According to Wilson, the General Staff ought to recommend that it become a battalion weapon. The Director of Staff Duties and the Director of Military Training did not, however, agree, arguing that the re-organisation of MMGs into brigade support groups had only just been decided. They believed that commanders in the field should implement those recommendations without any further changes.[51] It seemed that certain members of the General Staff refused to accept the role of the DInf who was now making it his job to assess the evidence and craft the infantry into a more effective tool.

Wilson's problems did not end there, for field formations also signalled a lack of enthusiasm for any changes to the existing distribution of small arms.[52] The main reason for this was that a sizeable number of unit commanders still believed that the rifle was the most appropriate weapon for service, irrespective of the battlefield evidence to the contrary. Undoubtedly they reasoned that the most effective infantryman was one who could make every shot count: one shot, one kill. However, many in the small arms community recognised that this preference did not necessarily reflect a rounded understanding of either the equipment or the most

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[49] Meeting of the Committee of Infantry Weapon Development, 8th July 1943, 120 Meetings – Conferences (Future Design of Weapons) – Box 2, MOD Pattern Room Archive.
[50] A similar request had been made during the First World War, see P. Griffith, Battle Tactics of the Western Front: The British Army's Art of Attack, 1916-1918, (London: Yale University Press, 1996), p. 131.
[51] Meeting of the Organisation and Weapons Policy Committee, 7th October 1943, WO 32/10515, NA.
[52] 'Summary of Replies Received from Middle East, North Africa and Combined Operations Headquarters to Questions asked in Progress Bulletin (infantry) relevant to Small Arms Development', 1st September 1943, 120 Meetings – Conferences (Future Design of Weapons) Box 2, MOD Pattern Room Archive.

appropriate way to use it.[53] In particular, reports from surveys conducted within 18 Army Group at the end of the Desert Campaign demonstrated that battalion commanders were not necessarily qualified to comment on the weapons being used on operations.[54]

Nonetheless, the DInf could not simply impose changes on field formations. Instead he had to find solutions that their commanders would be happy with. Accordingly the initial response of the Committee on Infantry Weapon Development was to pursue the development of a self-loading rifle.[55] Whilst the proposal ran counter to the work being conducted by operational researchers, clearly this was an idea that had been inspired by feedback coming from field formation HQs still wedded to the No.4 Rifle.[56] As compromises went, the self-loading rifle had the potential to increase the volume of fire a soldier could generate without sacrificing the range provided by the existing rifle.

The only sticking point for the DInf was the nature of ammunition then available to Britain. Rimless cartridge cases made an automatic weapon more reliable by reducing the number of failures caused by feeding and extracting rounds from its firing chamber. However, the only rimless rifle round that could be manufactured in Britain was the German 7.92x57mm used in the Royal Armour Corps Besa tank machinegun (MG) but made famous by the MG34, MG42, FG42, and the Mauser k98. It therefore made some sense to consider this class of ammunition for future investigation.

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[53] 'Summary and Consolidated Report by WTSFF on Infantry Questionnaire and Answers from Units in First and Eighth Armies on Conclusion of N. African Campaign May 1943'.
[54] Ibid., p. 3.
[55] Minutes of various meetings of the Standing Committee on Infantry Weapon Development dated 24th June 1943, 2nd July 1943, 8th July 1943 all in 120 Meetings – Conferences (Future Design of Weapons) Box 2, MOD Pattern Room Archive.
[56] 'Summary of Replies Received from Middle East, North Africa and Combined Operations Headquarters to Questions asked in Progress Bulletin (Infantry) relevant to Small Arms Development', 1st September 1943.

However, what swung the argument in favour of the 7.92mm ammunition was the fact that since December 1941, Belgian engineers, from a Liège based manufacturer called *Fabrique Nationale d'Armes de Guerre* (FN) had been working on two prototype self-loading rifles, chambered to fire 7.92mm ammunition.[57] Known in the UK as the Self-Loading Experimental Models 1 & 2 (SLEM 1&2) this FN group had originally been working on these weapons before the war but had been forced to escape from occupied Europe with the blueprints wrapped around their bodies. Bearing in mind the advanced state of these designs, if the British Army was to be armed with a unique self-loading rifle produced in Britain and using ammunition available in the UK then it would have to be based on a manufacturing capability that might be easily expanded. Accordingly, it could come as no surprise that the DCIGS would agree to allow experimental work on automatic weapons using the 7.92mm round as a basis for further investigation.[58] In the process, the DCIGS's decision officially sanctioned the experimental efforts on the SLEM 1&2.

Whilst the DCIGS was happy to see that work was being undertaken on an experimental self-loading rifle he also recognised that producing sufficient ammunition and weapons to replace the No.1 and No.4 Rifle whilst in the middle of war was impracticable.[59] Britain simply did not possess the manufacturing capacity to develop and produce enough small arms and ammunition to replace everything that was already in service.[60] Moreover, in September 1944 following the liberation of a large part of Belgium, the Belgian designers responsible for the SLEM had returned to Liège and taken with them their knowledge and design notes, thereby severely hampering the ADE's efforts to develop a self-loading rifle based on a 7.92mm round.[61] Changing to some kind of automatic infantry weapon designed for

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[57] Dugelby, EM-2 Concept and Design: a Rifle Ahead of its Time, p. 15.
[58] Memo from the Secretary of the Organisation and Weapons Policy Committee, 31st January 1944, WO32/105, NA.
[59] Meeting of the Organisation and Weapons Policy Committee, 4th January 1944, WO 32/105, NA.
[60] See note 23 above.
[61] Technical issues with British designs of 7.92mm ammunition caused problems with the SLEM; problems compounded by the departure of the Belgian designers and their design notes. On the 2nd January 1945, the A/CEAD was compelled to institute a system of Data Books to be held as a central repository of information about a design. This call was repeated a year later on the 5th February 1946.

issue to every soldier would have to wait until after the war when the technical problems associated with its ammunition could more easily be sorted out.

Having established a bureaucratic mechanism for bringing the small arms community together Major-General Wilson successfully went on to encourage the systematic identification and analysis of the equipment and organisational needs of the infantry. This was only possible once the various experts were around the same table working from the same data and towards a common goal. By acting as the focal point for a number of different but intimately related activities the DInf played a crucial role in determining that lighter weapons with increased rates of fire could help provide the infantry with more tactical flexibility. At the same time whilst the DInf was willing to challenge received opinion on equipment design, it became apparent that many unit commanders believed that there was still a need for the rifle. Clearly any new design of weapon would have to satisfy those who wanted to retain the capabilities provided by the SMLE and No.4 Rifle. But if future small arms were to enable the infantry to fight more flexibly then they would need to be useful in close quarter combat as well. Whereas the Sten might satisfy those concerned with tactical flexibility it could not keep happy those who were still committed to range and deliberate aimed fire. A new design of firearm would be necessary if both the small arms community and the field forces were to come to agreement. Given the difficulties posed by war this was not to happen until hostilities had ended.

In January 1947, the Ministry of Supply proposed a series of monographs on various weapons and their designs. At the time the ADE was too busy to do the work and felt it unnecessary. However, in their correspondence they reveal that no one could write about the SLEM 1 as those connected with it had left the department and no one else was available who could do the work. See 121 Design of Weapons, Box 4, and 121 Design of Weapons Box 6 for relevant correspondence all in MOD Pattern Room Archive.

The Armament Design Establishment[62]

For the DInf the EM2 represented an opportunity to increase the tactical flexibility of the infantry. Without the efforts of the Small Arms Group of the Armament Design Establishment (ADE), however, these ambitions would have come to nothing. It was the ADE that was responsible for interpreting the requirements of the Infantry and defining an appropriate solution for the battlefield problems that they faced. But the ADE did not just develop the EM2 simply because small arms research and development fell into its functional remit. Rather, members of the ADE had a more partisan interest in the EM2, intimately connected to a desire to retain a design capability within the UK. This next section is therefore concerned with making explicit the reasons for the ADE's commitment to the EM2 and demonstrating how it went about making a case in support of its design. To do this justice it is necessary to give a brief description of the inter-war small arms community and the process for developing small arms. This is then contrasted with the more scientific approach promoted by the ADE after 1945. What emerges is the way in which the establishment chose to influence policy primarily by advocating the underlying scientific approach that they had adopted in designing the equipment. In this the ADE was clearly of the opinion that a scientific methodology would demonstrate the objectivity of its decisions. That the science invariably reflected the interests of the ADE is a point the establishment would have trouble brushing off later.

The ADE was part of the Ministry of Supply and was split up into a number of departments responsible for a variety of equipment types. Whilst others were involved in activities associated with designing larger artillery pieces, the Small Arms Group (SAG) was in charge of the design and development of Britain's small arms. Answerable to the Director General of Artillery, the ADE emerged after the end of the Second World War with a much greater range of facilities and capabilities

[62] Before the war the ADE was known as the Design Department. During the war the Design Department was renamed the Armament Design Department. This nomenclature was retained until about 1947 when it was renamed the ADE. For the purposes of this paper the terms DD/ADD/ADE are, broadly speaking, referring to the same body of people responsible for designing small arms and ammunition.

than it had had before 1939. In particular, according to Commander Mitchell, the Chief Engineer Armament Design (CEAD), the SAG was now, '...capable of dealing with complete design and the Department [i.e. the ADE] was determined that it should not be allowed to return to its pre-war condition'.[63] Although the SAG was in charge of making sure that their designs took into account the problems of mass production, the job of manufacturing the weapons fell to the RSAF.

Prior to the Second World War, Britain's ability to research and design infantry weapons was limited.[64] There were a number of reasons for this. One of the most important was the lack of an explicit and standardised process for weapon development. This meant that the manner in which equipment was piloted into service was dependent on the oversight and management of the Ordnance Board (OB).[65] If one of the services wanted a new weapon then they submitted to the OB a general idea, or rough specification.[66] This was translated by the Board into firm specifications. The Design Department at Woolwich, the precursor to the ADE, would then be asked by the OB to produce detailed drawings in accordance with that specification so that the development of a prototype might then begin. However, because the function of this branch was simply concerned with producing drawings it was not expected to be critical in its assessment of the requirement. This was a point reinforced by the fact that it had no experimental facilities or budget independent of that provided by the OB. The Design Department did not, therefore, play any part in interpreting General Staff requirements.

Once the drawings had been produced the process might take a number of turns. One reason for this was that there were no fewer than eight different departments

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[63] Meeting of the Advisory Council on Scientific Research and Technical Development, 26th November 1946, 121 Design of Weapons Box 3, MOD Pattern Room Archive.
[64] For a fuller appreciation of the poor state of British preparedness see, Proceedings of a Special Meeting of the Small Arms Committee, January 27th 1937, MOD Pattern Room Archive.
[65] O. F. C. Hogg, The Royal Arsenal: Its Background, Origins, and Subsequent History 2 Vols., (London: Oxford University Press, 1963), Volume 2, p. 995.
[66] M. M. Postan, D. Hay and J. D. Scott, Design and Development of Weapons: Studies in Government and Industrial Organisation, (London: H.M. Stationery Office, 1964), pp. 435-436.

involved in bringing equipment into service.[67] Because several of the groups would have responsibility for both small arms and artillery, they would have to master the problems associated with both types of ordnance.[68] This was not a particularly satisfactory state of affairs in part because it was realised that the internal and external ballistics of small calibre firearms differed fundamentally from larger calibre weapons.

But the problems did not end there. Of the factories that did have a responsibility to turn a drawing into a prototype, a culture of piecework in shop tool rooms ensured that they were produced only by those staff who had a specific obligation for set functional tasks. Invariably this lack of flexibility led to delivery delays exacerbated by the fact that the eight departments concerned were located in at least three different places: Woolwich, Hythe and Enfield.[69] By necessity, this ensured that each new weapon had to travel all over the southeast of England as it progressed through its development cycle. The effect of all of this was that the necessary expertise to deal with small arms was never fostered or gathered into one location.[70] If it had been, Britain's preparation for the forthcoming war might have been more effective.

When war finally came, however, the ad hoc procedure adopted by the OB could not cope with the demands placed upon it. By necessity, the Design Department was reorganised on more functional grounds, moved from Woolwich and expanded so that it could initiate designs and evaluate proposals. For the first time a specific section designated with the task of designing infantry weapons below a calibre of 40mm was established at the Drill Hall in Cheshunt. This was named the Armament

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[67] For a more detailed account of the problems facing the small arms community see Proceedings of a Special Meeting of the Small Arms Committee, January 27th 1937, MOD Pattern Room Archive. The eight departments were headed up by the Chief Superintendent Research Department, Superintendent of Design, Chief Inspector of Armaments, Chief Inspector Small Arms, Superintendent Royal Small Arms Factory, Superintendent Armaments Factories, Superintendent Royal Filling Factory and the Experimental Officer at Hythe.
[68] Ibid.
[69] Ibid., p. 8.
[70] Ibid., pp. 66-69.

Design Department. Under the leadership of Colonel Shepherd, Assistant Chief Engineer Armament Design (A/CEAD), the department developed many weapons including the various marks of Sten machine carbine;[71] established a basic thirteen step process that made the ADD central to planning, experimenting and developing prototypes of weapons; expanded the staff to approximately 170; and effectively relegated the Ordnance Board to the role of managing the trials process.[72] When the war was over it was this organisation, renamed the Armament Design Establishment (ADE) that was directly responsible for the design and development of both the EM2 and the ammunition that it used.

Having explored the history of UK small arms development before and during the war, it might be thought that the role of the ADE is self-explanatory. However, within its broad remit to design infantry weapons it is useful to note what the ADE was not in a position to do. Given the structure of the Ministry of Supply, the ADE was not responsible for 'selling' a particular solution. Its role was simply to ensure that specifications were realistically framed and that the designs actually went a substantial way to solving battlefield demands. That is not to say that members of the establishment did not have a vested interest in persuading the War Office to adopt the equipment they had created but rather that their activities were not expected to be partisan. Nevertheless, the assertion that the ADE did not have a bureaucratic imperative to create firearms that matched its own situated point of view would run contrary to the evidence. That this was the case can be demonstrated by the way in which the ADE worked to develop the EM2 based on scientific research methods then popular at the Ministry of Supply.[73] Clearly an

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[71] The Sten was designed by Colonel Shepherd and Mr Turpin. As per tradition, the first two letters of the weapon's name were taken from the first letters of the surnames of those who had designed it, whilst the EN represented Enfield – the location of the RSAF.

[72] For design process and organisation charts see 121 Design of Weapons Box 4, MOD Pattern Room Archive. It has not been possible to define precisely how many staff there were at any one time during the war. However, from a role call list developed to make an ADD response to invasion easier, 170 staff are recorded see 111 ROF Box 3, MOD Pattern Room Archive.

[73] For a scientist's view on the use of science within the British system of government see, C. P. Snow, The Two Cultures: and a Second Look. An Expanded Version of the Two Cultures and the Scientific Revolution, 2nd edn, (Cambridge: Cambridge University Press, 1964). For a revisionist

approach informed by science would help to define and arbitrate between the various design possibilities. But this way of working also immunised the ADE from critics who might be inclined to argue that the department's real ambition was organisational self-preservation.

Firstly, it was realised even before development of the EM2 properly got underway that it might be possible to identify more effective ammunition and that some kind of investigation into an 'ideal' calibre was warranted. Accordingly, an Ideal Calibre Panel was set up, chaired by the physicist Dr Beeching, Deputy Chief Engineer at the ADE in February 1945.[74] After much analysis, this finally reported in March of 1947. The Panel outlined a complete set of theoretical possibilities in terms of varieties of ammunition calibres and explained the respective trade-offs each would entail if an effective light automatic weapon were to be developed.[75]

Secondly, Mr Jungermann, an engineer from Austria who had worked for the Germans on a number of weapons including the MG42, developed a new and more accurate method for measuring the performance of a weapon. In Britain, during the war, kinematic cameras had been used to photograph the internal functioning of the bolt mechanism. However, this approach did not make it easy to establish the velocities of the moving parts.[76] Jungermann's device, known as 'Mickey Mouse' in the department, made it possible, for the first time in Britain, to measure properly on a 'shadowgram' the speed of changes in the interior of the weapon.[77] This information proved invaluable to the designer who had to make changes to a firearm's chamber or firing pin on a scale of thousandths of inches.

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interpretation of the relationship between the British state and its scientists, see D. Edgerton, Warfare State: Britain, 1920-1970, (Cambridge: Cambridge University Press, 2006).

[74] Meeting of the Sub-Committee of the Committee on Infantry Weapon Development, 8th February 1945, WO 32/10515, NA and CAB 21/3057, NA.

[75] The Choice of a Standard Round for Small Arms, Technical Report No.5/47, Armaments Design Department, March 1947, DEFE 15/239, NA.

[76] Dugelby, EM-2 Concept and Design: a Rifle Ahead of its Time, p. 34.

[77] Ibid., p. 35.

Finally, the design establishment recognised the limits of its own knowledge and actively chose to engage with the scientific community. Accordingly, in November 1946, the ADE organised an Advisory Council on Scientific Research and Technical Development. This Council brought together academics from Cambridge and Bristol with engineers from a number of British manufacturers who were asked for help on a range of issues. These included developing: a more effective method for establishing the wear and tear in rifle barrels in ultra high rate of fire weapons; new and lighter materials that could replace wood furnishings on rifles; investigating barrel movement and its effects on accuracy; improved propellants for more efficient cartridge design; optical sights; and electric guns.[78]

Nevertheless, even though the ADE chose to wield its influence in a measured way resorting to science to defend its point of view, it also realised that if it did not make use of the resources available to it, a prime opportunity to make a contribution to the British Army would be lost. As Noel Kent Lemon, Assistant Chief Engineer Armament Design (A/CEAD) and the project manager on the IPW programme acknowledged, '...there was very little "know how" in Great Britain...' before 1939.[79] During the war it had been possible to grow the establishment by employing a number of designers who had escaped from occupied Europe, including some Belgians, Czechoslovaks and Poles and also draw on Dominion expertise. Yet even before fighting in Europe came to a close, these teams began to disperse back to their home countries, making it hard to maintain capability. In addition, by 1945 it was clear that Britain faced a financial crisis which the newly elected Labour Government was anxiously looking to avoid. One of the most obvious places to cut costs was in the realm of defence and especially research and development. There was, therefore, a very strong possibility that the Ordnance Departments would be pared back to pre-war levels.[80] As it was, when the War Office finally issued a

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[78] See 'Advisory Council on Scientific Research and Technical Development', 26th November 1946.
[79] Dugelby, EM-2 Concept and Design: a Rifle Ahead of its Time, p. 15.
[80] Historically speaking, as wars ended the Ordnance Departments were usually cut back to their pre-war levels, see T. Putnam and D. Weinbren, A Short History of the Royal Small Arms Factory Enfield, (Enfield Middlesex University, 1992), p. 112. In January 1947 the total R&D spend was £180.4million of which the Minister of Defence contended £66.1 million was for basic research that

formal requirement for a new infantry weapon in September 1947, Kent Lemon only had 22 staff that he could deploy on the task set by the DInf.[81] The pressure was on if the ADE was to survive in any meaningful way.

So long as the ADE could come up with a solution that keyed directly into the battlefield problems unearthed by the DInf and the Committee on Infantry Weapon Development there was a chance that Britain would retain a small arms design capability. If it could not then it was very likely that small arms development would go into decline, much like it had during the inter-war period. The IPW was therefore the best chance the ADE had for survival and the Ideal Calibre Panel the most objective way in which to show that any design suggestions being made were not based on bureaucratic imperatives but scientific fact. The ambition was to put scientific discourse at the heart of the debate. This was not simply about technological solutions but avoiding a form of language that would put technicians at a disadvantage. For with a scientifically justifiable solution to the Army's battlefield dilemmas, the engineers knew that they would then be in a stronger position to defend their establishment's capability. This was not just a case of cynically manipulating the debate. On the contrary, the ADE's engineers believed in what they were doing. That said, however, the ADE could not be described as anything but an extremely partisan supporter of its own battlefield solutions.

The Director General of Artillery and the Director of Artillery (Small Arms)

If the EM2 represented tactical flexibility for the DInf and survival for the ADE, then for the Director General of Artillery (DGofA) and especially the Director of Artillery (Small Arms) (DofA (SA)) the EM2 was the weapon solution most likely to fulfil everyone's needs. Given the organisational structure of the Ministry of Supply, the DGofA and the DofA (SA) were the advocates for the ADE at the War

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had a civil spin off. The Chancellor, however, reckoned that the £66.1million was 'excessive'. As it turned out the Treasury was forced to increase R&D spending in the short term because the British Government decided to develop a nuclear capability. C. Barnett, The Lost Victory: British Dreams, British realities, 1945-1950, (London: Pan Books, 1996), p. 73.

[81] 'Notes of a Design Meeting on .270" Automatic Rifle held on 25th November 1947', 340 (200) EM 1&3 SL Rifles Box 1, MOD Pattern Room Archive.

Office. However, because they also had to provide more general advice on technical matters to the Army the approach they had to adopt had to be extremely subtle. If they behaved in an obviously partisan manner their credibility would be undermined. At the same time if they did not speak out loudly enough in favour of a particular technical solution their role would be redundant. The DGofA and DofA (SA) were then the conduits between the user and the engineers, playing a crucial role in shaping the terms of the debate both in the War Office and the ADE. This next section is therefore devoted to exploring role and interests of the DGofA and DofA (SA) in relation to the EM2. In particular the efforts of Brigadier Barlow are examined. As the DofA (SA) for most of the development cycle of the EM2, Barlow showed particular skill in balancing the demands of both the user and engineer. This is partly explained by his longstanding passion for seeing the British Army firing a British designed firearm. But it is also the case that the EM2 represented Barlow's belief in the skill and quality of the ADE as well as his conviction, based on his wartime experience, that the weapon was actually what the infantry needed.

Of the three DGofAs and one DofA (SA) involved in its development all maintained consistently positive views of the EM2.[82] Broadly speaking the DGofA and DofA (SA) had similar interests and points of view. Both were determined to present the Ministry of Supply in the best possible light and both worked to convince the War Office that products suggested by their Department were superior to any alternative. However, their roles were not synonymous. Whereas the DGofA was the head of both the artillery and small arms research and development groups at the Ministry of Supply, his junior the DofA (SA) was only responsible for small arms. The DGofA was in charge of negotiating, agreeing and signing off general research guidelines with the War Office relating to all areas of his responsibility.[83] But more than this, as the most senior technical advisor to the Army Council, the DGofA often had

[82] The three DGofAs were: 1938-1945 – Major-General E Clarke; 1946-1948 – Lt-General W Eldridge; 1949-1952 – Brigadier Lambooy. Major-General H Paterson (1953-1956) was DGofA as the FN FAL was trialled. The DofA (SA) was Brigadier Barlow.
[83] Postan, Hay and Scott, Design and Development of Weapons: Studies in Government and Industrial Organisation, p. 252.

access to the highest echelons of the General Staff where he gave his opinion on equipment matters. This ensured that he could influence the debate on weapons even before a General Staff policy statement was promulgated.[84]

Before the start of the Second World War the DGofA reported to the Master General of Ordnance (MGO). With the outbreak of hostilities, however, the MGO and his subordinates were moved out of the War Office to the Ministry of Supply and the MGO was renamed the Director General of Munitions Production.[85] As a result of this change a Weapon Development Committee was formed at the War Office where negotiations over equipment research and production priorities were held.[86] At this committee the DGofA was responsible for presenting the capabilities of the Ministry of Supply's research teams. Here he had to negotiate with his counterpart within the office of the DCIGS, the Director of Weapons and Development (DWD). The DWD was responsible for collating a list of equipment priorities from the various War Office arms directors for further discussion at the committee.

By contrast, the DofA (SA) worked on a day-to-day basis with the DInf. His formal task was to communicate requirements from the DInf to the ADE and to explain to the DInf what the ADE could realistically design. This was not just a case of telling each group what information was required in order to complete various research and development tasks. Rather, this was about shaping the terms of the debate by educating the user about what was possible technically and translating the users' preferences into achievable goals for the ADE. The most obvious place where the DofA (SA) asserted his influence was at the Standing Committee on Infantry Weapon Development. This position enabled the DofA (SA) to introduce technical ideas and get immediate feedback from users as to the veracity of the suggestion. It also meant that the DofA (SA) could circulate a technical idea and build support for it among his key constituency and in particular with the DInf. In effect, a

[84] Ibid., pp. 366-367.
[85] After the war the Ministry of Supply re-organised once more and this role was disaggregated further. The new title adopted was the Controller of Supplies (Munitions) (CS(M)). The CS(M) had responsibility for both R&D and production of small arms and artillery munitions.
[86] Memo from DCIGS to Secretary of State, 22nd February 1946, WO 32/10506, NA.

combination of the DGofA shaping the way the General Staff saw a technical problem and the DofA (SA) influencing the DInf at the Committee on Infantry Weapon Development ensured that there were powerful voices working for the ADE at the War Office.

As an example of how influencing policy might work, it is worth describing Brigadier Barlow, the DofA (SA) from late 1945 until mid-1953. As a rare two-time winner of the King's Prize at Bisley, Barlow was recognised as a keen marksman, a member of the Army Eight shooting team sixteen times and its captain between 1925 and 1946. Apart from his involvement in the Army shooting team, Barlow also shot for Britain at the 1948 and 1952 Olympics.[87] Before the war, whilst Assistant Superintendent at the Design Department at Hythe, he had given evidence to the Special Meeting of the Small Arms Committee investigating the inefficiencies of British small arms development and so he knew very well how far the design establishments had come since 1937.[88] During the war, Barlow was deputy head of the Weapons Technical Staff (WTS), a group concerned specifically with small arms, at the Ministry of Supply. This team gathered field data on small arms and, alongside their Army Operational Research Group colleagues at the War Office, had the task of working on the difficult nexus of problems associated with relating users and technical items.

As part of his work with the WTS, Barlow had been to Tobruk in September 1941 and reported on whether equipment and ammunition that reached the troops met their needs, arrived in good working order, was provided in sufficient quantities and packaged correctly to facilitate easy distribution.[89] He was subsequently made responsible for gathering feedback on infantry weapons in the First and Eighth

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87 See, 'The King's Prize at Bisley', "Ça Ira", September (1938), p. 7 and Obituary entitled, 'Brigadier J. A. Barlow, CBE', White Rose, May 1975, p. 7. Barlow also wrote several books on rifle shooting the most famous of which was J. A. Barlow, The Elements of Rifle Shooting Dealing with the Service Rifle and Open Sight, (Aldershot: Gale & Polden Ltd, 1932). By 1961 this book had made it to a fifth edition.

88 See 'Special Meeting of the Small Arms Committee', January 27th 1937.

89 Report of Lt-Col J. A. Barlow on Visit to Tobruk, 7th -17th September 1941, (200) 200 Small Arms General Box 2, MOD Pattern Room Archive.

Armies at the end of the North African Campaign.[90] Finally, as a member of the Standing Committee on Infantry Weapon Development he was in a position to see how WTS reports coming out of the 21st Army Group were received by the DInf, Major-General Wilson. He was, therefore, an ideal candidate for the job of DofA (SA) because his intimate knowledge of the user and his understanding of the technical issues facing the Ordnance Departments were extensive.

Barlow's approach was informed by his knowledge of the actors involved. He worked tirelessly to make sure that any future ammunition and weapon would match not just the letter of the specification but more precisely address any underlying concerns held by the Committee of Infantry Weapons Development. For example, in March 1949, the DofA (SA) compelled the ADE to collect its materials together into the form of a sales pitch to the General Staff. This was known as 'Operation Niblick' and was arranged in three stages so that the Staff could see the solution on offer to them. The aim was to ensure that the user properly understood three things: firstly that ammunition below .30" would give them everything they required in terms of hitting power at certain specified ranges; secondly that the decrease in calibre from .303" would make it possible to develop a lighter and handier weapon; and, thirdly, that one of the weapons on display would provide a possible solution.[91] The key for Barlow and the ADE was for the Staff to understand that the ammunition was the weapon and not the rifle. If they understood this then they might be persuaded to adopt the ADE solution.

More than this, however, Barlow used Niblick as a way of managing the expectations of both the General Staff and the ADE. The purpose of Niblick was, therefore, twofold. In the first instance it represented a chance to make sure that General Staff understood the value of, and were happy with, the EM2. Bearing in mind that some officers would view an automatic weapon as incompatible with

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[90] See 'Summary and Consolidated Report by WTSFF on Infantry Questionnaire and Answers from Units in First and Eighth Armies on Conclusion of N. African Campaign May 1943'.
[91] 'Operation Niblick', Ammo .280 – 1 .280" (7mm) Ammunition 82 Series File, MOD Pattern Room Archive.

accurate shooting, Barlow could use his reputation as a marksman to dispel the fears of those who believed that the EM2 would result in the degradation of the infantry's skill at arms. At the same time, Barlow could use Niblick to make sure that the ADE understood the magnitude of the task ahead of it; that every effort was needed if they were to convince the General Staff of the technical efficacy of the solution suggested. In this respect Barlow was playing good organisational politics. Not only did he demonstrate an understanding of how technologies stabilised in practice but he also showed considerable insight into the way the War Office and Ministry of Supply preferred to make decisions. By organising 'Niblick', the DofA (SA) reflected a realisation of the point that the ADE solution was capable of being interpreted differently by different interest groups. His efforts were as invaluable to the infantry as they were to the ADE.

Conclusion

To conclude, this chapter has outlined the three relevant social groups who went on to advocate the EM2 solution: the Director of Infantry, the Armament Design Establishment and the Director General of Artillery/Director of Artillery (Small Arms). For each social group the EM2 meant something slightly different. For the DInf, the EM2 was about the development of a weapon system that would provide the infantry with tactical flexibility. The small arms platforms that had been available during the Second World War might have provided an effective solution but they were not acceptable to field formations. Therefore a new system was needed. This had to combine the qualities of the Sten machine carbine and the No.4 Rifle. The war had shown the inadequacies of relying on an ad hoc approach to weapon development. Future requirements had to be based on well-founded data collection and sound argument.

For the ADE, the EM2 was about the development of a weapon system that might secure the future of the establishment. The ADE was well aware of its history and knew very well that without war the status of the department was uncertain. That the ADE preferred to employ reasoning based on scientific methodology did not necessarily mean that the establishment was working in a bi-partisan manner, seeking ontological solutions to the problem of superior weapons. On the contrary, the object of the science was to discover an alternative way of conceiving of small arms questions with the ADE intending to be the first to capitalise on the outcomes of the research.

Finally, for the DGofA/DofA (SA), the EM2 represented the opportunity to develop a British firearm for the British Army. To this end these actors worked to ensure that the DInf and the ADE were both working along the same lines. Inherent in this was the need to direct the DInf toward stating requirements that the ADE could achieve. At the same time the ADE had to ensure that its solutions were of a kind that would be attractive to the War Office. Fundamentally this meant that the DGofA/DofA (SA) had to understand the organisational contexts that all the other social groups were working within in order to sustain their position on small arms and shape the terms of the debate so that all the protagonists might achieve their different objectives. This suggests that the DGofA/DofA (SA) were fully conversant with what they would need to do if they were to see the EM2 adopted by the British Army.

Chapter Five - The Experimental Model 2

Constructing arguments in support of the EM2

In 1946, with the pressures of war production fading away it was possible for the War Office to re-examine the whole small arms question once more. In the opinion of the DInf, the battlefield requirements were clear. Tactical flexibility demanded a lighter rifle that could generate greater volumes of fire. This would enable the soldier to suppress an enemy position more easily and advance to close quarters. However, bearing in mind the laws of physics, this could only be achieved within certain parameters. If the ammunition calibre was large then the firearm would have to be heavier so that it might absorb recoil energies more effectively. This would compromise the weight of the weapon which in turn would limit tactical flexibility. Conversely, if the designer chose not to increase the weight of the weapon then it would prove increasingly difficult to control, especially on automatic fire. Accordingly, the only realistic way to develop a lighter rifle with increased rates of fire was for the ADE to suggest a smaller calibre round. This would reduce the recoil generated and allow the soldier to carry more ammunition. The sticking point was that if the General Staff chose an existing round then there was the possibility that they might also select an already available rifle. Such a decision would be disastrous for the DInf and Ministry of Supply who were of the opinion that existing ammunition and weapon types were either appropriate for close quarter fighting or engaging targets at range but not necessarily both. Effectively then, without a new class of ammunition, the EM2 advocates believed that they would not be in a position to develop a new type of weapon.

The central theme of this chapter is therefore concerned with exploring how the EM2 advocates made their case for changing the armament of the British infantryman whilst explaining why the weapon system took the form that it did. As already demonstrated, agreement about what a future firearm ought to be capable of had been reached between the DInf, ADE and DofA (SA) by 1944. However, it did not follow that either the rest of the General Staff or even commanders of infantry battalions viewed the battlefield problem and the proposed solution in the same way. Indeed, many officers remained wedded to a particular view of marksmanship that they associated with the SMLE and which emphasised the need for accurate, long range fire produced by deliberate aiming. Despite the fact that the evidence available to the DInf produced different conclusions, the EM2 advocates could not simply ignore the opinions of these officers. Many of these critics had ultimate responsibility for sanctioning equipment selection and would need to be won over using arguments that could engage with and address their concerns.

In this respect and as this chapter makes clear, the advocates faced two significant problems. The first was that up until 1949 they did not possess a fully working example of the kind of firearm they believed necessary for the infantry. The second was that as of March 1943 the General Staff had committed the British Army to a changeover from the existing .303" rimmed cartridge to a design of rimless cartridge compatible with the US Army. If the EM2 advocates were to stand a chance of realising their goal to develop a new British class of ammunition and a lighter automatic weapon to fire it then they had to show that their alternative solutions could work. The move to US/UK ammunition standardisation and the lack of a prototype firearm only served to hamper these ambitions by complicating the number of factors that had to be considered whilst the advocates were making their case for change.

Recognising their dilemma, the DInf, ADE, and DofA (SA) knew that they had a difficult task ahead of them if they were to stand a chance of successfully moving official General Staff policy in their direction. As this chapter shows, the strategy the EM2 advocates adopted in their initial efforts to win over the Staff were directed towards exploiting the findings of the Ideal Calibre Panel's scientific analysis of various ammunition calibres. Not only did this approach validate the advocates' perspective but it also moved the terms of the debate on to more objective grounds. But whilst the EM2 advocates might have preferred to use this form of analysis in their endeavours to persuade the critics it became clear that the science would not be enough to win the argument. Instead, the advocates would have to adapt their position in order to take into account entrenched War Office views on US/UK ammunition standardisation. Ultimately this meant abandoning some of the findings of their scientific research and in its place promoting the idea that British ammunition would meet US requirements as well. The upshot of these negotiations was an agreement that allowed the advocates to continue with their plans to develop lighter, fully automatic firearms whilst retaining the principle that the UK would adopt SAA that was acceptable to the United States.

Given the complexity of the story this chapter is organised thematically into two parts and considers a time period that stretches from 1943 until 1949. The first half reviews the development of ammunition and in particular how the DInf, ADE and DofA (SA) tried to persuade the rest of the War Office that their solution matched both the battlefield requirement and could satisfy US demands. The second half is concerned with why a bullpup design was deemed an appropriate rifle configuration given the ambition to create a weapon that could be used for close quarter fighting and engaging with targets at range. Whilst non-British reactions are considered in the next chapter, the emphasis here is on how the General Staff perceived the suggestions being made by the EM2 advocates. Having done this it then becomes possible to understand the basis upon which the British tried to persuade their counterparts in the US Army to standardise on equipment developed by the ADE.

The Ammunition

As far as the EM2 advocates were concerned, with the end of the war in 1945 the question that needed most urgent resolution was related to small arms ammunition (SAA). Without a change of ammunition it would not be possible to develop a lighter firearm capable of generating higher volumes of fire. As stated in the previous chapter, it had already been accepted by the DCIGS in January 1944 that a change to a rimless cartridge was a necessary first step in order to achieve this. However, the DInf, ADE and DofA (SA) recognised that if the General Staff were to choose an existing type of rimless SAA then it would become difficult to develop a new type of firearm that could function as both a self-loading rifle and a machine carbine. Accordingly, the advocates believed that the key issue at stake was convincing the General Staff that a new round was necessary if the Army were to have a weapon that gave the infantry the tactical flexibility Second World War experience indicated they needed. The purpose of this section is, therefore, to examine how the EM2 advocates made their case for a new class of ammunition. In order to do this justice it is important to develop the respective points of view of the EM2 advocates as compared with a diffuse group of General Staff who were unconvinced by those arguments made in favour of a British round. Given that Staff officers regularly rotated positions on average every two years,[1] this group had no singular defining demographic bar the fact that their opinions usually surfaced at meetings of the Organisation and Weapons Policy Committee (OWPC). For that reason, it is important to understand the function of this committee, establish who attended and what role they played.

The focal point for opposition to a British weapon solution was the OWPC. This was the decision making body responsible for advising the Chief of the Imperial General Staff (CIGS) on matters relating to weapons policy. The committee's origins dated back to July 1942 when it was known as the Weapon and Development Committee.[2] At that time it had been created to, '...formulate General Staff policy on research, design and production of weapons and equipment which the Army required'.[3] By July 1943, however, it was realised that it was also necessary for the

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[1] The policy originated before the war with the reforms by the then Secretary of State for War Hoare Belisha in July 1939. .In the case of the DInf this meant that, on average, each officer served two years in the post before moving on. By contrast, the Ministry of Supply barely rotated those people involved in the development of small arms. Apart from the DGofA position which changed three times in ten years the key personnel heading up the team preparing designs for the IPW remained the same for the whole of the project See B. Bond, British Military Policy Between the Two World Wars, (Oxford: New York: Clarendon Press; Oxford University Press, 1980), p. 54; D. French, 'An Extensive Use of Weed Killer: Patterns of Promotion in the Senior Ranks, 1919-1939', in The British General Staff: Reform and Innovation,1890-1939, B. Holden-Reid and D. French (eds.), (London: Frank Cass, 2002), pp. 159-174.

[2] This is not to be confused with the Weapon Development Committee referenced previously in Chapter 1 on the EM2. The Weapon Development Committee as noted earlier was a liaison committee intended to consider the application of Staff policy as formulated at the OWPC.

[3] Paper by DCIGS discussing the reorganisation of the Organisation and Weapons Policy Committee, 12th June 1944, WO 32/10504, National Archive (NA).

General Staff to take into account the organisational implications of some of the decisions that they made in relation to equipment design and the brief of the committee was widened.[4]

The reformulated committee was chaired by the DCIGS, at that time Lieutenant-General Weeks, and contained representatives from each of the arms directors such as the DInf as well as the Director of Weapons and Development (DWD) and Director of Staff Duties (DSD). The OWPC was responsible for considering policy changes that might occur if modifications to the organisation and equipment of the Army were undertaken. Whilst officers advising the Staff from the Ministry of Supply, like the DGofA, did not have voting rights they were often invited to attend and contribute to meetings.[5] Also present, though without voting rights, were representatives of the Commonwealth countries.

Having discussed proposals, the DCIGS would formulate recommendations which he would document and take to the CIGS for approval. If political endorsement were required the document would then be shown to the Minister of State and if agreement were reached a General Staff policy statement would be produced. Inevitably the OWPC had a wider remit than that possessed by any one Directorate within the War Office. Consequently, any changes that the DInf wanted to undertake were subject to considerable scrutiny from other parts of the organisation which might have other policy agendas. This fact made it certain that the DInf would have to develop a variety of arguments and strategies to win over his colleagues on the committee if he were to move the agenda on SAA towards his preferred solution.

It will be recalled from the previous chapter that the EM2 advocates had been working on the 7.92mm SLEM 1&2 for most of the war. This had not proven to be

[4] At this time the responsibility for scheduling and implementing policy decisions was handed over to the Weapon Development Committee as referenced in the previous chapter.
[5] Existing War Office Machinery for Specification and Provision of Equipment, Committee on War Office Organisation for Specification and Provision of Equipment, Note by the Secretary, 8th November 1948, WO 163/339, NA.

particularly fruitful, especially once the Belgian designers had returned to Liège. Even though the EM2 advocates were looking at the SLEM, the OWPC was reluctant to move towards 7.92mm ammunition whilst Britain was committed to fighting alongside and dependent on equipment provided by the United States.[6] As of March 1943, it had been General Staff policy to pursue a changeover to rimless ammunition as soon as hostilities permitted, '...regardless of financial, production and other considerations...'. Specifically, however, the policy went further and stated that American standard calibres ought to be chosen wherever possible.[7] As a result, the British Army was set to adopt - depending on future US small arms policy - the .30'06 calibre round and M1 Garand rifle once the war against the Axis powers was over. By January 1944, after lobbying by the DInf, this policy had changed to allow the experimental work conducted by the ADE on 7.92mm ammunition to continue but it also explicitly stated that all future research efforts should be directed towards developing a round that was compatible with US preferences.[8]

Committed to developing a British self-loading rifle, the decision either to adopt US equipment or create a round that would be acceptable to the Americans was not popular with Major-General Wilson and did not echo the views of the Standing Committee on Infantry Weapon Development. However, as indicated in the previous chapter, the General Staff's policy did reflect the fact that Britain's own manufacturing capacity was incapable of quickly re-equipping the British Army with small arms.[9] Following the disaster at Dunkirk, for example, the RSAF had to increase production significantly to meet the shortfalls caused by the evacuation of the BEF. Unfortunately for the Army re-armament was a slow process. At a time

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[6] Memo from the Secretary of the Organisation and Weapons Policy Committee, 31st January 1944, WO32/105, NA.

[7] No doubt this was partly driven by the recognition that the Ordnance Factories had had some trouble delivering sufficient .303" ammunition during the first two years of the war and that there were a vast number of .30'06" weapons in Britain, see PREM 3/46/3, NA. The staff policy on adopting US ammunition can be found in General Staff Policy Statement on Rimless Small Arms Ammunition, 20th March 1943, WO 32/10515, NA.

[8] Memo from the Secretary of the Organisation and Weapons Policy Committee, 31st January 1944, WO32/105, NA.

[9] For an indication of the prevailing sentiment of senior wartime manufacturing administrators in Whitehall see R. Holmes, In the Footsteps of Churchill, (London: BBC, 2005), pp. 202-203. See also Chapter Four, footnote 23.

when the number of men in uniform had risen from 224,000 in 1939 to 2,453,000 in 1942, the number of No.1 SMLEs that had been manufactured totalled only 177,491.[10] At the same time, production of the No.4 Rifle - a version of the No.1 SMLE that had been designed for ease of manufacture - only started towards the end of 1941. On top of this production of ammunition was hampered both by German air raids during 1940 and the time taken to bring US manufacturing plant into the UK, set it up and sort out any teething problems.[11]

Nevertheless, despite the difficulties caused by the slow speed of rearmament, the DCIGS also recognised that the changeover even to American types of infantry weapons whilst still at war could not be implemented immediately.[12] The advantage that would come from aligning small arms and ammunition production across the Anglo-Saxon world had to be balanced against the disruption caused to infantry units, training establishments and logistical infrastructure whilst Britain was still fighting. This meant that for those, like the DInf, who preferred a British solution to the SAA question there was until the end of the war to come up with plans for something new.

However, before the EM2 advocates could make their case for a completely new type of firearm, one based on British rather than Anglo-American requirements, they recognised that they would have to explain to the OWPC why they could not simply implement the General Staff policy and adopt existing US equipment. According to the ADE there were several reasons for why the US .30'06 round and M1 Garand rifle were inappropriate for British service. Firstly, they argued that the M1's use of an eight round clip mechanism made the rifle hard to re-load. Secondly, they pointed out that the adoption of .30'06 ammunition would result in having two distinct cartridges in an infantry battalion at the same time: one for the .30'06 Garand and one for the .303" Bren LMG and Vickers MMG. This would complicate

[10] For No.1 SMLE production figures see, PREM 11/854, NA. Data on the size of the wartime British Army can be found in J. Crang, The British Army and the People's War, 1939-1945, (Manchester: Manchester University Press, 2000), pp. 144-145.
[11] see PREM 3/46/3, NA.
[12] Meeting of the OWPC, 4th January 1944, WO 32/10515, NA.

logistics and make it harder to swap ammunition between weapon systems in an emergency and when unit reserves were low. Thirdly, the ADE was aware that the Americans were redesigning their existing cartridge so nothing would be gained from prematurely converting to a round that would become outdated. Fourthly, the .30'06 round was longer than the .303" cartridge. Consequently it would be both difficult and extremely costly to change the length of the firing chamber in existing British firearms so as to make room for the longer American cartridge.[13] Finally, the ADE argued that changing to an American calibre would compromise existing Army organisational practices. They wrote,

> It can be said in general that American weapons are technically efficient. Since, however, organisation is fundamentally based on weapons whether individual or demanding a weapon team for their maintenance in action, unless British and American organisations and tactical employment can be brought into line, it is difficult to assess the battle-worthiness of American weapons vis-à-vis our own.[14]

These arguments amounted to a powerful battery of technical and organisational reasons for avoiding a changeover to US equipment. More than this they also formed the basis upon which the EM2 advocates would build a case for a completely new standard of ammunition.

With the replacement of Major-General Wilson by Major-General Wimberley in December 1944, the first proper attempt was made to try and develop a new British calibre of ammunition.[15] Having a similar perspective on tactical flexibility to that of his predecessor, Wimberley decided in February 1945 to establish, with the help

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[13] Meeting of the Committee on Infantry Weapon Development, 13th August 1943, 120 Meetings – Conferences (Future Design of Weapons) – Box 1, MOD Pattern Room Archive.
[14] 'Report on the possibilities of adopting American Weapons for use in the British Service', 25th March 1946, CEAD, 200(200) Small Arms General Box 2, MOD Pattern Room Archive.
[15] Wimberley was formerly commander of the 51st Highland Division, a unit that had chased Rommel across North Africa and landed on Sicily. Having been injured in Italy, Wimberley had been compelled to return home where upon recovering he became commandant of the Staff College. He was appointed DInf in 1945.

of the DGofA and DofA (SA), an Ideal Calibre Panel.[16] As far as the DInf was concerned the purpose of this panel was to investigate new small calibre ammunition and furnish the EM2 advocates with the arguments necessary for winning over the OWPC.[17] In the process it was clearly Wimberley's intention to align the thinking of the Committee on Infantry Weapon Development with that of the General Staff. This could only be done once the EM2 advocates had a fully tested counter-proposal. The problem facing the DInf, however, was the fact that, at that time, he did not have an alternative British solution to the .30'06 round with which he might persuade other members of the Staff.

This became more of an issue for the EM2 advocates when General Kirkman, the new DCIGS, decided to push ahead with plans to adopt the US .30'06 round in 1946. Whilst it would be hard to make a case stating that Kirkman was a particularly strong proponent of the US calibre, it is clear that he viewed its adoption as the most pragmatic way to implement General Staff policy and bring about technical change within the British Army. By 1945 the M1 Garand might not have been the state-of-the-art in rifle design according to the Standing Committee on Infantry Weapon Development but to the non-technical DCIGS it did have a distinguished service record. Indeed, a large number of .30'06 weapons had been used by Britain's armed forces during the war. The Home Guard, for example, made extensive use of the Pattern 17, an American rifle chambered to fire .30'06 ammunition.[18] The Army would still have to procure large numbers of M1 Garand

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[16] Meeting of sub-committee appointed by the Standing Committee on Infantry Weapon Development, 8th February 1945, WO 32/10515, NA.
[17] Ibid.
[18] The British Government bought 119,000 of these weapons in 1940 and issued them to the Home Guard. See, Hogg, Jane's Guns Recognition Guide, p. 272. As an aside the Pattern 17 (P17) was a version of the British Pattern 13 (P13). The P13 was developed by the RSAF prior to the First World War. Based on the same principles as Mauser K98 and the Springfield M1903 the P13 fired a .276" calibre round. Prior to the start of hostilities in 1914, the Army decided to abandon the P13 because of ammunition difficulties. However, because of the demand, Britain was forced into issuing orders for a revised P13 chambered in .303" calibre. This weapon, known as the Pattern 14 (P14), was primarily built by the American company Winchester. When the United States entered the war in 1917, despite their need for firearms, the US Army refused to adopt .303" rimmed cartridges and decided to re-chamber the P14 to take the .30'06 round. It was with a sense of irony, therefore, that Britain's armed forces found themselves compelled to take the P17 in 1940. See Hogg, Jane's Guns Recognition Guide, p. 270 and p. 272.

rifles or convert existing British weapons to the new ammunition. However, bearing in mind the financial pressures the General Staff was starting to face, Kirkman recognised that the cost of changing to a rimless round could be offset if Britain adopted US standard equipment and made use of the existing stockpiles. Considering the quantity of US made material in the country, the question for General Kirkman was how much it would cost to make the change to .30'06.[19]

In early 1946, in order to resolve the issue, the then DWD, General Sir Alexander MacMillan of MacMillan, was asked by the DCIGS to examine the question of whether the Army should adopt US ammunition or move to an alternative calibre. When MacMillan reported to the OWPC in April 1946, the evidence presented to the committee came down in favour of adopting the .30'06 round. The principal reason for this was that the DInf had not taken into account new cost constraints that were beginning to have an effect on the decisions of the Army Council. The financial argument against the .30'06, proposed by the EM2 advocates, was based on the dimensions of the cartridge case. If existing weapons were to be converted from .303" to the American calibre then the chamber and receiver for each firearm would require fundamental redesign to accommodate the additional length of the .30'06 round. However, as a result of the DWD's investigations it was found that the cost of changing over to .30'06 was only £25million and not the erroneous figure previously quoted of £200 million.[20] In May 1946, Kirkman consequently recommended to the CIGS, Field Marshal Montgomery, that Britain adopt the .30'06 forthwith and wrote to the Dominions to find out whether this policy would meet with their approval.[21] All wrote back agreeing to the proposal and thus a new General Staff Policy Statement was issued in July.[22] With the agreement of the

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[19] Meeting of the OWPC, 18th April 1946, WO 32/10515, NA. It had already been stated at a Standardisation Conference between Britain and the Dominions that Units would be held at 75% establishment strength and financial stringency would affect equipment decisions more than anything else. In effect they were told to, '...cut our coat according to our cloth', Introductory Address to the Standardisation Conference, 1st February 1946, WO 32/11606, NA.

[20] The £200 million figure was almost certainly a figure circulated by the DGofA. Meeting of the OWPC, 18th April 1946, WO 32/10515, NA.

[21] Letter from DCIGS to CIGS, 31st May 1946, WO 32/10515, NA.

[22] General Staff Policy Statement No.63, 20th July 1946, WO 32/10515, NA.

Commonwealth countries it seemed clear that the UK would adopt the .30'06 calibre of ammunition and in the process achieve standardisation with the US.

At this point, without a technical solution to counter the decision to adopt the .30'06 round the EM2 advocates had to find other ways of creating the time in which the Ideal Calibre Panel might be given opportunity to produce ideas for an alternative suggestion. In the summer of 1946, the ADE's .270" and .280" rounds were theoretical pipe dreams which held out the possibility of increasing the infantryman's firepower and lightening his load. But at the time the DCIGS was looking to adopt .30'06 ammunition they did not yet exist, the Ideal Calibre Panel had not reported and the tactical requirement for a smaller calibre, high velocity round had not been articulated by the DInf to the General Staff. Accordingly with their financial cost argument in tatters, the EM2 advocates had no other basis for protesting about the new Staff policy.

Nevertheless, the three protagonists resolved to find a way of creating sufficient breathing space for the Ideal Calibre Panel to report in the hope that its findings would provide the foundations upon which a case for a British ammunition solution might be made. The approach that they adopted lay with obscuring US intentions concerning the development of a new calibre to replace the current .30'06 in the hope that they could then capitalise on this lack of clarity. The strategy had little to do with outlining a list of the merits of their own solution over those of the .30'06 because the characteristics of a future British round had yet to be defined. Rather, the hope of the EM2 advocates was to create enough uncertainty so that they could gain time for the Ideal Calibre Panel to report. The Panel's findings would then furnish the DInf with arguments in favour of an attractive technical alternative to that offered by the Americans. At the same time, the General Staff were more likely to choose the certainty that came from adopting a new UK class of ammunition over a US design with no clear developmental finish date. As the DGofA and DofA (SA) were the General Staff's main suppliers of information with regards to US research and development efforts this strategy was reasonably easy to implement.

Whilst the War Office had its own military representatives at the British Embassy in Washington, the channel that provided the most useful source of information regarding US equipment decisions came from technical officers from the Ministry of Supply attached to the British Joint Services Mission (BJSM). The BJSM made regular reports relating to a variety of projects undertaken by the US Ordnance Department to the DWD as well as the DGofA and DofA (SA). In the spring of 1946, on the basis of intelligence from the BJSM, the OWPC were of the opinion that they could adopt the American .30'06 ammunition without fear of the US military authorities changing to a new calibre 'for some years to come'.[23] By late July new information coming from Washington suggested that the US Ordnance Corps were a lot further advanced in the development of a new round, known to the British as the Savage, than previously understood.[24] The BJSM warned that the old standard would be supplanted by the Savage in less than two years, which meant that if the British went ahead with their proposals to adopt the .30'06 they would be moving prematurely to a redundant round. At the same time, there was some indication that the US would not change over to its new standard until either it had run down existing stocks of its .30'06 or the beginning of a new military emergency.

The DWD was, as a result, left in a difficult position and at a meeting of the Weapon Development Committee in October 1946, asked that production and development priorities regarding the imminent UK adoption of the .30'06 round be altered to account for this new state of affairs.[25] He went on to state that he believed the situation warranted a completely new General Staff policy statement. With the DWD so unsure about US intentions, the BAS felt the need in February 1947 to write to Major-General Festing, MacMillan's replacement as DWD, to make

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[23] Meeting of the Organisation and Weapons Policy Committee, 18th April 1946, WO 32/10515, NA

[24] Letter from BJSM to DWD, 'Future Small Arms Ammunition Policy', 31st July 1946, WO 32/10515, NA.

[25] Minutes of the meeting of the Weapon Development Committee, 10th October 1946, WO 32/10515, NA.

absolutely clear what information they had provided regarding US intentions.[26] They apologised for any misunderstandings and stated that they believed that the DWD should have been told what was happening by the Ministry of Supply.[27] They pointed out that the DofA (SA) had been in the picture since 1944 and been given regular updates by the BJSM ever since.

It would be hard to claim that the BJSM deliberately intended or was instructed to deceive the DWD. However, with a little help from the DInf, DGofA and DofA (SA) it was decidedly possible to obscure US intentions in relation to small arms policy. In November 1946, for example, the DGofA wrote to the DWD suggesting that the new US round would not result in significant advantages over the existing US standard calibre. Additionally, he claimed that it would also potentially leave the Army needing two separate types of ammunition: one for small arms up to the section level and another for battalion weapons such as the MMG. As the Vickers MMG would still need .303" ammunition, this would complicate logistics. Moreover, whilst there might be appropriate tactical reasons for having two types of ammunition, as far as the DGofA was concerned in times of peace due weight ought to be given to the principle that, '...the fewer types of round required the more certain is it that the necessary quantities will be available where and when required, especially in the early stages of a war'.[28] Accordingly, he made the following recommendations: firstly, he stated that the Ministry of Supply ought to continue to examine how best to convert existing weapons to .30'06 calibre; secondly, that the War Office stay closely in touch with developments in the US but make no decisions about adopting the new round; and thirdly, that the Ministry of Supply be asked to press ahead with the efforts of the Ideal Calibre Panel.

Following these deliberations the DCIGS accepted the DGofA's analysis and asked that the Ideal Calibre Panel report its findings as soon as possible. Four months

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[26] Letter from BAS, Brigadier Huxley to DWD, Colonel Gracroft, 30th March 1947, WO 32/10515, NA.
[27] Ibid.
[28] Letter from DGofA to DWD (cc DInf), 'Introduction. Priorities for Conversion of Small Arms to .300', 5th November 1946, WO 32/10515, NA.

later, in March 1947, the Panel finally published its results stating that future ammunition ought to have a calibre ranging from .250" to .270" depending on what the bullet's core was made from.[29] The EM2 advocates had successfully created the conditions in which the Ideal Calibre Panel could produce its findings and they now had a firm proposal for an alternative to the US .30'06 round. However, after all this effort, the recommendations made by the Panel were not the ones taken by the EM2 advocates to the War Office for approval. Instead they proposed a calibre with a larger bore ranging from .270" to .280".[30] Why did they do this?

In order to answer this question it needs to be remembered that the work of the Ideal Calibre Panel had been started in February 1945 as a result of a meeting between the then DInf and the DGofA.[31] These talks had emphatically stated that the British infantry wanted to adopt a weapon whose, '...main object was to achieve the ideal calibre for our own use...' and that the, '...primary object was not standardisation with the USA....' [32] The explicit objective of the Panel was to, '...facilitate the design of the most efficient weapons and ammunition compatible with the lightest weight...' and their starting place was derived from the work of the Standing Committee on Infantry Weapon Development which had defined a list of requirements for SAA in 1944 at the behest of Major-General Wilson.[33] These stated that the ammunition should be capable of firing out to a maximum of 800 yards with an accuracy grouping for 5 rounds of 3 inches at 200 yards and have a trajectory that was as flat as possible, especially at 600 yards. The rounds were to be smoke and flash free and come in a variety of types to include, standard ball, incendiary, observing and armour piercing. Finally, the SAA was to have the potential to be used in a self-loading rifle, a sniper's rifle and a light automatic gun.

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[29] The Choice of Standard Round for Small Arms, Armament Design Establishment, Technical Report, March 1947, DEFE 15/239, NA.
[30] Directive for the Development of New Automatic Rifles, from A3, Brigadier Barlow to A/CEAD(SA), 18th September 1947, Ammo .280 - 3 .280" (7mm) Ammunition, MOD Pattern Room Archive.
[31] Lieutenant-General Macready of the British Army Staff was also in attendance at this meeting.
[32] Minutes of Meeting held at War Office between DInf, DGofA and others, 22nd June 1945, WO 32/10515, NA.
[33] General Staff Policy Statement No.3, 27th November 1944, WO 32/10515, NA.

If it was decided that it could also be used in an MMG, where the range requirement was for greater distances, then that would be an advantage. This however, was intended as a stretch target and not meant to compromise the ability of the engineers to produce the most appropriate ammunition for the other weapons platforms.[34]

Given the initial terms of reference then, the Ideal Calibre Panel had reported without considering whether its proposals would satisfy the OWPC's objective of standardisation with the US. Unhindered by the need to satisfy American requirements the Panel focused its investigations on ammunition compatible with achieving the desired ballistic qualities out to 800 yards as defined by the DInf in 1944. It was only after the EM2 advocates realised how important US/UK ammunition standardisation was to the DCIGS that the Ideal Calibre Panel's recommendations were amended to take into account the reality of the debate within the War Office. In this respect, the new proposals were designed to match the .30'06 round in a few key areas in the hope that the DCIGS would agree that standardisation might be achieved on British rather than American terms. Accordingly, in the summer of 1947, the EM2 advocates stated that they would build a round that would have the striking energy of at least 87ft/lbs at 2000 yards or the equivalent to that produced by a .30'06, 150 grain bullet fired at 2750fps.[35] As only larger bore ammunition could achieve these conditions the DofA (SA) took the decision to modify the Ideal Calibre Panel's report. The decision to develop ammunition with calibres ranging from .270" to .280" was therefore the response of the EM2 advocates who were simply adapting their suggestions to reflect the reality of the debate as they found it at the War Office in 1946-47.

Considering the technical state of the art at that time, the suggestion for .270" ammunition proved to be nothing more than a sop to the efforts of the Ideal Calibre Panel. After 14 months of development the ADE finally acknowledged that the

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[34] Ibid.

[35] DofA (SA) Directive on SA Weapon and Ammunition Development Programme for the Future, 18th September 1947, Letter from DofA (SA) to ADE, DGofA, and DOF, Ammo .280 – 3 .280" (7mm) Ammunition, MOD Pattern Room Archive.

.270" could not achieve the same striking energy as the US .30'06, given the mass of the bullet and the speed at which it could be made to travel. Accordingly, by November 1948, the DofA (SA) had to concede that in the time allowed it was not possible to bring the .270" to an acceptable level of maturity.[36] Work on this ammunition was not dropped altogether as there was considerable political capital to be gained with both the General Staff and the Americans if it could be demonstrated that the calibre was at least technically viable. Nevertheless, it was put further back down the priority list in favour of ensuring that the .280" ammunition was ready for trials with the Americans.

Ultimately, given the uncertainty surrounding the intentions of the US concerning their own SAA the DCIGS found it easier to agree in the summer of 1947 to the compromise range of rounds proposed by the EM2 advocates. This left the DInf, DofA (SA) and ADE believing that they could continue work on developing ammunition suitable for the British Army. At the same time the EM2 advocates promised the DCIGS that they would deliver SAA that could match the US .30'06 round. The price the EM2 advocates would have to pay in order to get the DCIGS's consent was to hold comparative US/UK ammunition trials. Initially scheduled for the spring of 1949, the EM2 advocates would now have to demonstrate that their round could match US Army requirements.[37] Clearly the EM2 advocates were willing to put aside those elements of the Ideal Calibre Panel's report if it made it easier for them to realise their goal of producing a weapon with greater firepower and less weight. However, just because the War Office might be brought around by this line of reasoning it did not follow that the US Ordnance Corps could be so easily persuaded. That this was the case will be demonstrated in the next chapter.

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[36] Minutes of Meeting held on new SAA, 26th November 1948, Ammo .280 – 3 .280" (7mm) Ammunition, MOD Pattern Room Archive.
[37] Telegram from Brigadier Barlow to General Eldridge, 27th June 1947, Ammo .280 – 1 .280(7mm) Ammunition 82 Series File, MOD Pattern Room Archive.

The Rifle

Having successfully persuaded the General Staff to accept their ammunition suggestions, this next section examines the arguments put forward by the DInf, ADE and DofA (SA) in support of a rifle to fire this new type of British SAA. Whereas the ammunition debate was largely held within the office of the DCIGS, when it came to the rifle, the EM2 advocates had to win support from members of the General Staff normally outside the equipment selection process. Having been asked to look into the matter by the CIGS, this new group of officers was drawn from the office of the Vice Chief of the Imperial General Staff (VCIGS), a department normally responsible for plans and operations. In order to make clear the reasons why officers from the office of the VCIGS were involved in the IPW debates it is important to understand the arguments first proposed in support of a new rifle. In the first instance these were outlined in a policy paper, submitted to the OWPC in the spring of 1947, laying out the infantry's future small arms requirements. An examination of this paper and the discussions that followed illustrates how the War Office was further divided between those who believed the Army needed a lighter rifle with increased firepower and those that felt this would undermine the shooting skills of the infantryman. This 'marksmanship' camp did not make itself immediately obvious to the DInf. Once it had, however, the final hurdle that needed to be jumped by the EM2 advocates involved satisfying this wider audience.

In December 1946, Brigadier Barlow indicated to a meeting of the OWPC that there was the potential to design one weapon that could replace both the bolt action rifle and the machine carbine.[38] Barlow's suggestions were based on an awareness of the small arms projects then underway at the ADE and his understanding of the infantry's requirements as examined by the Committee on Infantry Weapon development and defined by the DInf in 1944.[39] Since at least May 1946, the ADE had been working to refine three existing rifle designs for potential application to whatever small calibre ammunition could be agreed with the War Office. On the

[38] Meeting of the OWPC, 19th December 1946, WO 32/10515, NA

[39] General Staff Policy Statement No.3, 27th November 1944, WO 32/10515, NA

assumption that the next weapon needed to increase the firepower and reduce the number of different small arms in the inventory, three design teams were set to consider the issues associated with developing a light firearm intended to replace the rifle, the machine carbine, the self-loading rifle and the LMG.[40] In line with wartime research on experimental small arms, all these weapons were chambered to fire 7.92mm ammunition. This was despite the fact that by November 1946 the A/CEAD was well aware that the Ideal Calibre Panel was likely to suggest a calibre up to a maximum of .280".[41]

By May 1947, the A/CEAD convened a further meeting to consider which of the prototypes should go on for further development. Bearing in mind that no definite agreement on ammunition had yet been reached between the Ministry of Supply and the War Office, the A/CEAD decided to proceed with the development of two of the three weapons.[42] Of these one was already in a bullpup design and the other which had a typical conventional layout was to be re-configured in a similar way.[43] The unchanged rifle had been created by the Czech, Captain Janusewaki and was called the EM2 whilst the re-configured weapon was renamed the EM1.[44] Thus, five months before a new General Staff Policy Statement was issued revising SAA policy, the ADE had already made key decisions about what the future infantry weapon would look like, selecting two rifles as the basis for further research.[45] In no way could this be described as designing the rifle around the ammunition, a slogan

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[40] Report of Meeting held on Monday 20th May 1946 to discuss Rifle S.L. 7.92mm for MP43 Ammunition, 120 Meetings Conferences Box 1, MOD Pattern Room Archive.
[41] Meeting of the Advisory Council on Scientific Research and Technical Development, 26th November 1946, 121 Design of Weapons – Box 3, MOD Pattern Room Archive.
[42] Infantry Combat Weapon, 27th May 1947, 120 Meetings Conferences Box 1, MOD Pattern Room Archive.
[43] The concept of moving the trigger housing mechanism forward of the magazine, however, was not new. Before the end of the Second World War the ADE had been handed the designs for an automatic bullpup weapon by Major Hall who was leaving for his native Australia. The ADE had also built a prototype LMG called the Korsac and sniper's rifle known as the Harris in the bullpup configuration. See Dugelby, EM-2 Concept and Design: a Rifle Ahead of its Time, pp. 7-24.
[44] At the same time the weapon designed by Major Hall (see footnote 42) was designated the EM3 but no further development work was undertaken on this weapon, see Ibid., p. 27. The lead designer for the EM1 was called Mr Metcalfe, see 'Infantry Combat Weapon, 27th May 1947'.
[45] As will be shown in the next chapter because the development schedule was so tight work on the EM1 was abandoned before the joint US/UK trials.

that the EM2 advocates sometimes used with the General Staff and in talks with the Americans to justify their design choices. Making a decision to develop a new class of infantry weapon based on such a radical bullpup configuration, without knowing what ammunition it would use, was bold. How could the choice be justified?

Given that the central ambition of the EM2 advocates was to increase the infantry section's firepower whilst reducing the weight a man had to carry, there were several advantages that could be derived from a bullpup over more traditional rifle designs.[46] In a conventionally configured rifle the wooden stock accounted for the vast amount of weight. The stock had two purposes. Firstly, it was located directly behind the main axis of the firing chamber where it was perfectly placed to help absorb excess rearward energy. Secondly, it allowed the soldier to rest his cheek across it so that he could aim the weapon. By adopting a bullpup design and removing the stock, the ADE successfully reduced the weight of the weapon. At the same time, however, they created a number of complications related to controlling excessive recoil and aiming the rifle. Developing a new unit sight that sat on a carry handle half way down the barrel meant the infantryman did not have to bend his head into a contorted position to aim the rifle. The question was whether the design teams could restrict the amount of recoil energy generated in the firing chamber to levels that would not result in an uncontrollable weapon.

The ADE's answer to this problem was twofold. Firstly, whilst the removal of the stock created challenges related to aiming the weapon, it also beneficially resulted in a straight line action where the barrel of the rifle was perpendicular to the shoulder of the firer. This meant that the recoil energies were more efficiently absorbed by the shooter's body, potentially making the weapon easier to control. Secondly, firing the weapon in full automatic mode would put the parts of the IPW under considerable strain that normally would have been alleviated by making the various components more robust. Achieving this invariably meant increasing the weight of the weapon. The ADE, however, recognised that if the calibre of the ammunition

[46] See appendix three for diagram.

could be reduced and the recoil energies of the propellant charge moderated then this would obviate the need to increase the strength and subsequent weight of the IPW.

When the EM2 advocates were making their case for a smaller round of SAA, they were therefore setting up the conditions in which they might more easily design a firearm that could be used both as a machine carbine and self-loading rifle. The flick of a lever would change the weapon from one mode of firing to the other. Crucially the removal of the stock did not compromise the length of the barrel so it was still possible to achieve reasonable range and accuracy. If, however, the ammunition became larger the rifle might still function perfectly well in the self-loading role but would probably become uncontrollable when firing automatically in the machine carbine or LMG role. If the aim was to give the infantry a weapon that could do at least two roles then the question of ammunition would be of extreme importance.[47]

The fact that the infantry wanted to develop a system which in effect reduced the number of weapons in the inventory was finally made explicit in a policy paper produced for consideration by the OWPC in April 1947.[48] This paper was put together by the DMT, General Keightley, in direct collaboration with members of the Standing Committee on Infantry Weapon Development and for the first time made explicit, to an audience beyond the EM2 advocates, the reasoning for the IPW. The DMT stated that, 'The last war emphasised the need to reduce the weight [of the rifle]... and to increase its rate of fire. Accuracy beyond 300 yards was not required.'[49] Accordingly there was a preference for an automatic weapon that would combine, '...the functions of the Rifle and the Machine Carbine....'[50] This

[47] This was eventually demonstrated by the .280" ammunition which when fired from the EM2 had a recoil energy limited to 7.4ft/lbs compared to 11ft/lbs when using .303" ammunition in a No.4 Rifle. As a result of the reduced recoil energies it was possible to fire 80 aimed rounds per minute compared to the bolt action rifle's 20. See Dugelby, EM-2 Concept and Design: a Rifle Ahead of its Time, p. 249.
[48] Future Requirements of Small Arms for the Army', Memorandum by the DMT, 19th April 1947, WO 32/10515, NA.
[49] Ibid.
[50] Ibid.

document stated explicitly that the requirement for scientifically accurate shooting out to 600 yards was no longer necessary and that the new automatic rifle need only be sighted to 500 yards. Other firearms in the inventory would take care of targets at longer distances. No rifle grenade was deemed necessary as a light mortar ought to be developed to fulfil this role.

As the DMT's paper pointed out there were several advantages that would come from combining the machine carbine and rifle into one weapon. Firstly, from a tactical point of view, the future availability of nuclear weapons made dispersion on the battlefield more likely. This meant that there was a requirement for a rifle that was as light as possible, facilitating easy mobility. Secondly, in terms of logistics, a reduction in the number of weapons and types of ammunition in the battalion would reduce the complexity of the supply chain and result in weapons taking up less maintenance time. Finally, smaller ammunition and fewer different weapons would make it easier to train a short service Army. It was well known that a full powered rifle cartridge had considerable recoil and this could put a soldier off from wanting to train with the weapon. Smaller ammunition would not cause this problem in the same way as the older .303" round. Moreover, one weapon with two roles would cut the amount of training time spent on learning how to use and maintain several different firearms. [51]

Whilst the document was accepted by the OWPC, given the difficulty in establishing the direction in which American small arms research was heading, the Committee was reluctant to let the Keightley paper become a policy statement.[52] At least one Brigadier present at the April meeting, '...feared that the automatic rifle might increase to a dangerous extent the weight of ammunition to be carried by a soldier in battle.' However, the DInf made the counter claim that, '...the need for good fire control and discipline would certainly be necessary, but... that the new ammunition would be lighter than our present and this, in its turn, would bring about a reduction

[51] Ibid.
[52] Meeting of the OWPC, 1st October 1947, WO 32/10515, NA.

in the size and weight of magazine etc.'[53] For the time being the DMT's paper had done enough for the OWPC to agree that the future IPW would be both automatic and function in the role of rifle and machine carbine. The EM2 advocates soon realised, however, that the General Staff beyond the office of the DCIGS might still needed some further convincing.[54] Accordingly, they stepped up their development programme for both the EM1 and EM2 whilst Brigadier Barlow put together plans for Operation Niblick as referenced in the previous chapter.

In March 1949, with the final phase of Operation Niblick complete and the British ammunition and EM1 and EM2 rifles at more advanced levels of development, the new DCIGS, Lieutenant-General Crawford, expressed his admiration for the weapon system and praised the efforts of the ADE.[55] However, this did not mean that the General Staff were completely won over. At this point the CIGS, VCIGS and a newly created role overseeing the DInf and DMT titled the Director General of Military Training (DGMT) started to look into the question of future small arms policy. Their renewed interest was prompted by the visit of Field Marshal Slim, the CIGS and successor to Montgomery, to an Army Rifle Association gathering at the Bisley Rifle Ranges in the summer of 1949. Whilst attending the meet Slim had seen a 'deplorable display of shooting' demonstrating the lack of confidence the men had in handling their weapons.[56] By contrast the RAF had over 1400 personnel shooting, won several of the important competitions and had a greater proportion of senior ranks present than the Army. Consequently, Slim sponsored a meeting chaired by the VCIGS to look into the improving the weapon handling and shooting skills of soldiers.

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[53] Brigadier Parkinson, New Zealand Representative, Meeting of the OWPC, 24th April 1947, WO 32/10515, NA.
[54] Letter from A/CEAD to DofA (SA), 'Standardisation with Canada, T25 rifle', 7th April 1949, WO 185/244, NA.
[55] Letter from DCIGS to DofA (SA), 17th March 1949, Ammo .280 – 1 .280" (7mm) Ammunition 82 Series File, MOD Pattern Room Archive.
[56] Minutes of meeting held by VCIGS in Hotel Metropole at 15:00 hours, 20th July to discuss "The steps to be taken to improve small arms shooting in the Army and further support for the Army Rifle Association", 20th July 1949, WO 216/324, NA.

When the CIGS-sponsored meeting convened in London in July 1949, the new DGMT, the former commander of the 1st Airborne Corps, General Gale, argued that contemporary problems with marksmanship stemmed from the false belief that automatic weapons would replace the rifle. In his view, 'Compared with the rifle in capable hands, automatic weapons are poor killers and heavy users of ammunition. The rifle is still the main and most economical weapon for killing infantry - one shot, one man.'[57] Gale emphasised his point by stating that infantrymen would need considerable training with the new automatic rifle if it came into service. This was required to prevent the soldier from immediately moving to sustained fire mode when well aimed shots would be more effective. Finally, despite the evidence collected by the Standing Committee on Infantry Weapon Development in favour of automatic weapons suitable for engaging targets out to 300 yards, Gale claimed that, 'The main value of the automatic rifle was that it cut out reloading by hand, which always takes the soldier a long time to perfect'.[58] What stood in the way of getting final agreement with the General Staff was, therefore, directly concerned with whether the infantryman could be trusted to know how to use his weapon in fully automatic mode.

Unfortunately for the EM2 advocates, the whole crisis might have been avoided if the Americans had stuck to the original agreement for comparative trials in March 1949. However, complications in the US Ordnance Corps' own ammunition and rifle development prompted them to ask for a postponement until early in 1950.[59] This left the EM2 advocates exposed to an additional nine months of scrutiny by very senior members of the General Staff who challenged the original conception for the IPW as laid out to the OWPC in April 1947. In the face of resurgent hostility toward a fully automatic rifle, urgent action was needed in order to avoid the IPW

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[57] Minutes of meeting held by VCIGS in Hotel Metropole at 15:00 hours, 20th July to discuss "The steps to be taken to improve small arms shooting in the Army and further support for the Army Rifle Association", 20th July 1949, p. 2, WO 216/324, NA.
[58] Ibid., p. 2.
[59] Notebooks called 'History of .280" and .270" Cartridges', p. 110, Ammo .280 – 3 .280" (7mm Ammunition), MOD Pattern Room Archive; Report entitled: 'To enable a decision to be made regarding section on TECSU 415', written by DofA (SA), 26th March 1949, WO 185/244, NA.

being abandoned before trials with the Americans got underway. Consequently, in order to save the programme, the advocates agreed to change the EM2 so that it could be used in one of two roles. The same basic firearm would now be issued to troops either as a self-loading rifle or as a fully automatic machine carbine. Given the bullpup design of the IPW, this change did not compromise the effectiveness of the weapon in any way. It merely required simple changes to the trigger mechanism which would prevent an infantryman from being able to switch between fully automatic and self-loading fire.

By the time an infantry commander's conference was held in October 1950, the point was explicitly established. Battalion commanders wanted no change to the balance of weapons available to an infantry section. Tactical flexibility was to be sacrificed in order to keep happy those members of the General Staff who were still committed to logistical prudence and unsure about the men's judgement in battle. Soldiers who had previously been issued with a No.4 rifle would get a self-loading IPW, whilst those who had a Sten would have the fully automatic IPW.[60] Bearing in mind the Sten was usually issued to officers and NCOs, the EM2 sceptics believed that this arrangement would get around the problem of trusting the rank and file to know when full auto fire was appropriate. With this concession the design of the weapon had stabilised and the EM2 advocates had reached final agreement with the General Staff as to what the new weapon should be able to do.

Whilst this new configuration did not satisfy the initial requirements defined during the war and supported by all the DInfs subsequently, there was enough in it to keep all happy. In the first instance the ADE and DofA (SA) had satisfied their own particular interests to develop a British solution. The DInf had to recognise that commanders were not yet ready to adopt a fully selective fire weapon despite the weight of evidence in its favour. Nevertheless, he could take solace in the fact that he had won an argument that might also have been described as the thin end of the wedge. The faster reloading time of the EM2 when functioning as a self-loading

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60 Infantry Commanders Conference, 6th to 13th October 1950, p. 12, WO 216/373, NA.

rifle would still permit soldiers to generate larger quantities of fire than they had previously and there was some tactical advantage in this. At the same time, the concept of one weapon configured into one of two roles could be challenged later when more evidence had been collated to show that the men in the field thought it hindered tactical flexibility. But for those of a more sceptical disposition, the EM2 also had much to offer. In the first instance troops would be issued with lighter weapons with greater functionality. At the same time, impulsive, ammunition-wasting shooting was restrained by limiting the fully selective fire version of the weapon to only those who previously carried the Sten. As these were mainly carried by officers and NCOs the trust and logistical implications could be controlled. Finally for those less persuaded by the battlefield evidence it was clear that the EM2, with a barrel of comparable length to a typically configured rifle, would not necessarily harm marksmanship skills. Both the sceptics and the advocates could find enough in the technology to allow it to proceed for trials with the Americans.

Conclusion

The question that needed the most urgent resolution for all the protagonists was that of the calibre of future small arms ammunition. If a small calibre round was adopted then it would be possible to build a weapon that met the needs of the infantry as understood by the DInf. However, it would be difficult to make a case stating that the selection of the .280" calibre round proceeded on the basis of an inherent technological logic. Instead, despite the theoretical and battlefield evidence available, the efforts of the EM2 advocates were founded on drawing attention to and capitalising on the unclear intentions of the American Army. That this was possible was entirely down to the fact that the War Office remained dependent on information made available by the small arms community responsible for building the EM2. Without access to another source of information it was difficult for those still committed to the idea of marksmen engaging targets at range to generate arguments that could be backed up by substantial evidence. In these circumstances, the Staff opted for a British solution of ammunition because of their uncertainty about what was happening on the other side of the Atlantic. The argument that the

EM2 advocates made for introducing an untried cartridge therefore reflected the practical difficulties of building a case for change that would work within the organisational context of the post-1945 War Office.

This might not have been such a problem but for the fact that OWPC wanted wherever possible to achieve standardisation with the US. US .30'06 calibre ammunition was capable of hitting targets out to 2000 yards. The .250" to .270" calibre range suggested by the Ideal Calibre Panel was too small to match American requirements. Accordingly the EM2 advocates decided to stretch the suggestions made by their scientific advisors in order to give themselves a chance of persuading the OWPC that their ammunition suggestions would meet US demands for engaging targets at distance. Second World War battlefield experience had shown the British that the power of the US round was unnecessary but the need to get the agreement of the General Staff was such that the DofA (SA) had no choice but to make concessions. The proposed .280" calibre round was not therefore the 'ideal' round but came about as a result of discussions within the War Office where it became clear that whilst American intentions were uncertain it was still extremely important to achieve ammunition standardisation. The .280" ammunition was consequently open to two interpretations. On the one hand it was optimised for British requirements which stated that an automatic firearm was necessary for ranges under 500 yards. At the same time, the OWPC believed that it would be capable of hitting targets out to 2000 yards and would therefore satisfy US demands. Both the EM2 advocates and the OWPC could see what they wanted in the ammunition.

In terms of the rifle, the EM2 advocates believed the ideal solution was to adopt a fully selective fire automatic. Certain members of the General Staff, however, remained unconvinced arguing that this would compromise marksmanship and potentially increase the strain on the supply chain as a result of increased ammunition usage. As a result and in order to keep the Staff on side, the EM2 advocates agreed to adapt the IPW so that specific members of the infantry section would have a selective fire weapon whilst others would have a self-loading rifle. In effect the idea of the IPW was interpreted by the advocates to mean a fully automatic weapon but in order to get it accepted it had to represent two different firearms to the General Staff. How this delicate balance of agreements was sustained when confronted with the institutional interests of the American Ordnance Corps and the belief that US/UK standardisation was worth more than tactical flexibility is something that will be investigated in the next chapter.

Chapter Six - The Experimental Model 2

EM2 opponents

By the end of 1949, the EM2 advocates had successfully managed to convince the various sceptics within the War Office that they had more choice than between the US .30'06 and continental 7.92mm rounds. That this was possible was entirely due to the efforts of the ADE which, as a result of 18 months' hard work, could show that their alternative type of ammunition was not only technically viable but also offered a commendable solution to the infantry's battlefield problems. At the same time, the ADE had also designed two bullpup rifles, the EM1 and EM2, which it believed would prove beyond doubt both the robustness of the .280" round and the soundness of British rifle design philosophy.

Unfortunately for the EM2 advocates, these efforts were not enough by themselves to bring about change in the armament of the British infantry. This was because wartime standardisation agreements between the Allied powers left officials in London and Washington keen for the emerging North Atlantic Treaty Organisation (NATO) signatories to adopt the same equipment. To be sure there were many logistical and manufacturing advantages to be gained by this. However, as far as the EM2 advocates were concerned, the issue also had tactical implications which, depending on whose equipment would become the standard of the future, had the potential to spill over into the way national armies fought and organised themselves. On top of this, the EM2 advocates recognised that if they failed to achieve weapon standardisation on UK terms then they might fatally undermine their importance in any future debates and expose themselves to the possibility of redundancy.

As the key protagonists saw it then, the question that the wartime standardisation agreements posed was related to whose equipment would become standard. In this respect, those powers not dependent on information provided by the EM2 advocates were considerably better placed to oppose the ammunition and rifles designed by the ADE. In particular, with a different perspective on infantry combat the Americans proved to be the least willing to accept standardisation on the terms set out by the British. According to the US Army and Bureau of Ordnance, evidence from the Second World War indicated that the battlefield requirement was for ammunition and a rifle that could provide the infantry with the accurate means to engage targets out to 2000 yards. As the existing .30'06 made this possible the Americans decided to stick to SAA with a .30" calibre but shorten the cartridge case in order to take advantage of changes in propellant technology. This new round, known as the t65 in the US and the Savage in Britain, would form the basis around which post-war US weapons would be built.

Bearing in mind that the EM2 advocates had consistently predicated their technical choices on the belief that infantry engagements were rarely fought at ranges beyond 600 yards, the American position posed a considerable challenge. As far as the advocates were concerned, the .30'06 round was an over-engineered solution to the problem. The need to engage targets at range was important but not as important as the need to have a weapon capable of generating sufficient fire appropriate for close quarter fighting. Thus the question that the EM2 advocates were trying to answer was related to whether ammunition and rifle could be optimised for automatic fire suitable for both distance and close in fighting. If it could, then the Americans might be convinced and standardisation achieved on UK terms. If it could not, then whose view of the battlefield might prevail and how would they win the argument?

The way in which opposition to the British proposals was marshalled therefore forms the focus of this final chapter on the EM2. Specifically the views of the American military establishment with regards to small arms are examined in detail and the underlying reasons for their attitude towards the EM2 exposed. This demonstrates that whilst the US Small Arms Section sought to undermine the British efforts on technical grounds it was the American view of the battlefield that underpinned their argument. Evidence from the user and technical trials drives that point home. Eventually both sides began to realise that the tests would be an insufficient mechanism for arbitrating between the American and British ammunition and rifle solutions. Simply put, US ordnance officials did not see ammunition lethality in the same way as their British counterparts and scientists on each side of the Atlantic could not resolve the differences. As a result, the decision on which weapon system to adopt would not be found on technical grounds alone.

In these circumstances, strong-arm tactics would need to be employed in order to bring about a resolution. To demonstrate how this worked, the chapter starts by discussing the American point of view on small arms and in particular their attachment to .30" calibre ammunition. Bearing in mind the fact that only two academic authors have written extensively about US small arms design in the period under consideration, the arguments advanced in this section draws heavily from their analysis. Having examined the US perspective, the chapter moves on to explore how the Americans worked to undermine the British position on ammunition. This then leads on to an examination of the different wounding criteria used by scientists on each side of the Atlantic and demonstrates how science could not help resolve the differences of opinion.

Having failed to reach agreement after the trials, the Americans sought other ways to undermine the EM2 advocates. Thus, the second half of this study looks at the way in which the Americans drew on the support of an additional range of actors in their efforts to upset British ambitions. Accordingly, the focus moves on to how the Belgian company *Fabrique Nationale d'Armes de Guerre* (FN) and the Canadian, French and Churchillian Governments reinterpreted the technical problems as originally defined by the EM2 advocates and compelled the War Office and Ministry of Supply to reconsider their small arms choices.

The Americans

In many respects the American attitude towards the British proposals relating to the EM2 were fundamentally conditioned by their appreciation for marksmanship and their commitment to .30" calibre ammunition. Symbolic of this was the US Army's attachment to the .30'06 M1 Garand. Brought into service in 1936 and described as the 'the greatest battle implement ever devised' by General George S. Patton, the Garand was the standard US rifle of the Second World War.[1] The tactical basis for introducing the M1 was the belief that a new infantry weapon had to match the Army's traditional values of long range accurate shooting with the need to increase the infantryman's rate of fire. If this could successfully be accomplished then it would be possible to mask the fact that, when it came to infantry tactics, there were two distinct camps within the inter-war Army, each with different views on how to engage with the enemy.

The first group included mainly higher echelon officers whose non-tactical experience of the First World War resulted in their continuing belief in marksmanship traditions.[2] The second group in contrast were more likely to have seen combat and had a closer appreciation of the battlefield. To this second group the First World War suggested that there were potential benefits that could be derived from increasing the rate of fire.[3] Having failed to collect enough sound data in a systematic manner it was difficult to prove this to be the case. However, the increased interest in automatic firearms by European nations and the acceptance of the Browning Automatic Rifle (BAR) into American service in 1919 underlined a tacit acceptance of the benefits of greater firepower.[4]

Nevertheless, achieving the ambitions of both sides in this debate was technically challenging. This was because the qualities required of a rifle that needed to shoot to long ranges with maximum accuracy were different from those where an increase in firepower was deemed necessary. High rates of fire invariably meant increased recoil energies and this affected accuracy. Reducing recoil involved filling a cartridge with less propellant and having a smaller calibre bullet or increasing the weight of the weapon to absorb more recoil energy. Changing the characteristics of the ammunition or increasing the weight of the rifle resulted in either a compromise

[1] McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, p. 32.
[2] Ibid., p. 25.
[3] Ibid., p. 27.
[4] Ibid., pp. 25-29.

on long range capabilities or making the weapon impossible to carry and use. The inter-war technical dilemma the US Army consequently presented the Ordnance Department was therefore extremely difficult to resolve.

The first attempt at finding an answer lay with the efforts of John Pedersen who was contracted to the Ordnance Department in 1928. Pedersen pointed out that by reducing the size of bullet to .276" it would be possible to develop a semiautomatic rifle of a reasonable weight and still maintain some of the range capabilities of the .30'06 round. Unfortunately for Pedersen this was not a view that was well received by the Ordnance Committee whose members included representatives from the combat commands, technical services and other liaison staff and whose responsibilities included setting specifications and overseeing research and development.[5] The reason the committee objected to the .276" was that in their opinion smaller bullets brought into question both the lethality of the round and the extent to which it could be deflected by cross winds. With insufficient independently documented data to support this view it was decided to organise trials, undertaken by a separate Caliber Board, to establish the lethality of Pedersen's .276" (and another of his possible candidates, the .256") round against the standard .30'06. This board, which became known as the Pig Board because the ammunition was tested on anaesthetised pigs, reported in 1929 that the Pedersen .276" was extremely lethal at 300 yards, just as lethal as the .30'06 at 600 yards and only slightly less lethal at 1000 yards.[6]

Despite the board's findings, however, the chief of the infantry was not so easily convinced, arguing that pigs were insufficiently like humans to establish ammunition lethality.[7] This objection led the Ordnance Committee to organise another set of trials which would be conducted on goats. In 1931, this so-called 'Goat Board' tested Pedersen's .276" semiautomatic rifle alongside two

[5] Ezell, The Great Rifle Controversy: Search for the Ultimate Infantry Weapon from World War 2 through Vietnam and Beyond, p. 24.
[6] McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, p. 30.
[7] Ezell, The Great Rifle Controversy: Search for the Ultimate Infantry Weapon from World War 2 through Vietnam and Beyond, p. 29.

semiautomatic rifles by John Garand, one of which was chambered to .276" and the other to .30'06. Unluckily for those who advocated a larger calibre, Garand's.30'06 weapon suffered a cracked bolt at the trials and left the Caliber Board reassured that their earlier conclusions concerning bullet size were correct.[8] Accordingly, and with Congressional funding for further trials in doubt, the Goat Board recommended the .276" round for service and Garand's semiautomatic weapon to fire it. The report went to the Ordnance Committee which agreed with the board's findings and was sent on to the War Department which still needed to give its final approval.[9]

Unfortunately for those on the Ordnance Committee who supported the smaller calibre, their recommendation still did not meet with the approval of the chief of the infantry who now objected to it on the basis that it was important to guarantee the inter-changeability of ammunition between rifles and MMGs.[10] Effectively, the chief of infantry was insisting that an infantryman use a high powered cartridge that was more relevant to the needs of an MMG than it was to the design of a rifle. For an MMG, weight and recoil considerations were of less significance as these weapons needed to be more robust in order to deal with their role of providing longer range sustained fire. In contrast, for the ordinary infantryman these issues were of critical importance in the design of their automatic rifle. The insistence on one class of ammunition for both an MMG and rifle meant limiting the chance of increasing the firepower that the ordinary rifleman could generate. For the chief of infantry, however, two issues were at stake, one with a tactical dimension and the other a logistical. The tactical issue was that inter-changeability guaranteed that in case of emergency a squad would have the ability to swap SAA intended for machine guns and use it in their rifles. The logistical issue concerned the fact that it was easier for one type of ordnance to be shipped to front line units in bulk than it was for two. An infantry company that needed .30'06 ammunition for its light machine guns and BARs and .276" for its semiautomatic rifles clearly had huge implications for

[8] McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, p. 31.
[9] Ezell, The Great Rifle Controversy: Search for the Ultimate Infantry Weapon from World War 2 through Vietnam and Beyond, pp. 29-32.
[10] McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, p. 31.

logisticians who were primarily interested in simplifying the supply chain, not increasing its complexity.

Animosity to the .276" did not end there, however. Even the chief of the Ordnance Department moved to distance himself from the Caliber Board's reports by arguing that changing calibre would mean replacing the tooling for both the .30'06 round and the various weapons that fired it.[11] With such a significant voice pointing out the financial consequences, logisticians arguing that a change would complicate the supply chain, and the chief of infantry unhappy about lethality and inter-changeability, senior Army commanders started to question the wisdom of the Caliber Board's findings. In particular they were concerned that a move to a new type of ammunition would not be well received by a Congress more worried about the Great Depression. Indeed, with a perfectly sound system already in existence, any spending on a new rifle was likely to lead to increased Congressional scrutiny which could undermine the administrative functions of the War Department.[12] With an eye on the political situation facing the Army, it could come as no surprise that the Chief of Staff, General MacArthur, decided to overrule the Caliber Board stating, 'To make this change will introduce an element of chaos, confusion, and uncertainty which, magnified under war conditions, would more than counteract the beneficial effect of any semiautomatic rifle'.[13] MacArthur stopped further research into .276" and instructed that more effort be made to find a solution using .30'06 ammunition.

MacArthur's decision would have set back the US development of a semi-automatic rifle by several years. However the Ordnance Corps were saved by the fact that John Garand had also been working on another firearm in his spare time, one that was chambered to fire the .30'06 round.[14] When Garand revealed that this new but untested self-loading weapon was only slightly heavier than the existing service rifle

[11] Ibid., p. 31.
[12] Ibid., p. 31.
[13] Ezell, The Great Rifle Controversy: Search for the Ultimate Infantry Weapon from World War 2 through Vietnam and Beyond, p. 30.
[14] Ibid., p. 33.

but did not involve a change of calibre, the US Army seemed to have an answer to its marksmanship/firepower dilemma that satisfied the interests of logisticians, ordnance officials and bureaucrats alike. Consequently in 1936, Garand's rifle was taken into service by the US Army.

Unfortunately for the British the legacy of the M1's design history was to have significant impact on the EM2 advocates when they came to reopen the calibre question in 1947. For whilst the Second World War prompted the US Army and the Ordnance Corps to re-examine the technical solutions they had previously reached in relation to infantry small arms, there was still much reluctance to move away from compromises previously reached. This was not least the case because the post-war head of the Small Arms Section of the US Bureau of Ordnance, Colonel Rene Studler, had also served on various inter-war Ordnance Committees and was the proof officer in charge of the experimental tests conducted by the Pig Board.[15] Studler was therefore very familiar with the arguments that had been made in favour of .30'06 ammunition and understood how hard it had been to reach an Army wide consensus on the calibre question.

Putting aside the fact that there was wide agreement on the value of .30'06 ammunition, by 1945 there were plenty of facts available to the Americans to indicate that the M1 Garand had achieved its reputation, 'in spite of, rather than because of, the rifle doctrine that inspired it'.[16] Significantly, the evidence directly undermined several strands of the arguments developed before the war in favour of the .30'06 round. Firstly, SAA inter-changeability was not considered by US field commanders to be a significant problem as the limited tactical advantage provided was, towards the end of the war, negated by the large quantities of ammunition being sent to the front lines already in loaded in clips or belts and ready for use. The logistician still held to the idea that there was some utility in inter-changeability but

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[15] Ibid., p. 50.
[16] McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, p. 33.

in general the line infantry did not.[17] Secondly, surgical studies of US casualties during the Bourgainville campaign suggested that the Pig Board's 1929 findings regarding round lethality were broadly correct.[18] Accordingly, the basis for resisting a smaller calibre that might enable the development of small arms with higher rates of fire was no longer valid. Thirdly, battlefield conditions were even less conducive to marksmanship than they had been during the First World War. Studies showed that as a proportion of the overall casualty rate, small arms fire accounted for the smallest number of casualties during the Second World War. Indeed, close examination of medical reports from the European and Pacific theatres showed that small arms fire accounted respectively for twenty-five percent and thirty-three percent of all casualties inflicted.[19] It was possible to argue, therefore, that there was even less reason for the infantry to be issued with a rifle based on marksmanship principles when other weapons in the inventory were more successfully employed on long range targets.

Most damning of all, however, was the analysis of operational researchers such as S.L.A. Marshall who argued that the real problem of small arms fire was not necessarily the need for accurate long range shooting but rather with building up the volume of fire.[20] On the basis of his investigations in both the Pacific and European

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[17] Ibid., p. 33.

[18] Wound Ballistics Report, Bougainville Campaign, 1944, pp. 16-15 and p. 69-82, Army Heritage and Education Center, Carlisle Barracks, USA.

[19] McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, pp. 33-34.

[20] In the past twenty five years much has been written to undermine Marshall's work. However, it must be remembered Marshall had a dramatic affect on the views of infantry officers and ultimately ordnance officials alike. There can be no doubt that Marshall made an important contribution to post-war small arms training and choices about infantry weapons. The M14/M16 controversy of the 1950s and 1960s, for example, was clearly underpinned by Marshall's thinking. For the M14/M16 controversies see, Ezell, The Great Rifle Controversy: Search for the Ultimate Infantry Weapon from World War 2 through Vietnam and Beyond and McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition. Marshall's writing on the battlefield can be found in, S. L. A. Marshall, Men Against Fire: the Problem of Battle Command, rev. 2nd, (Norman: University of Oklahoma Press, 2000); S. L. A. Marshall, Infantry Operations & Weapons Usage in Korea, 2nd edn., (London: Greenhill Books, 1988). For a discussion of the Marshall controversies see, F. Smoler, 'The Secrets of the Soldiers Who Didn't Shoot', American Heritage, Vol: 40, No: 2 (1989); R. J. Spiller, 'S.L.A. Marshall and the Ratio of Fire', JRUSI, Vol: Winter, (1988); J. W. Chambers, 'S. L. A. Marshall's Men Against Fire: New Evidence Regarding Fire Ratios', Parameters, Vol: Autumn, (2003).

Theatres, Marshall claimed that on average no more than twenty-five percent of front line troops actively used their personal weapon even in the most severe of engagements.[21] Putting this down to the fact that the US infantryman came from a civilised society where the taking of life was prohibited and unacceptable, Marshall observed that riflemen were least likely to use their weapons.[22] Instead, soldiers armed with automatic and crew-mounted firearms were more likely to shoot because they believed that they would be important to the outcome of the battle.[23] Indeed, the majority of the active firers used heavy weapons, were in small groups together and used several firearms in such a way that, 'if the machine gun went out, they picked up a rifle; when they ran out of rifle ammunition, they used grenades.'[24] Getting the men to fire was important because, as Marshall wrote, 'Fire wins wars, and it wins the skirmishes of which war is composed. Toss the willing firers out of an action and there can be no victory.'[25]

Training clearly was one part of the solution to the problem of achieving fire superiority but another conclusion that the US Small Arms Section had started to reach during the war included increasing the rifle's rate of fire. Consequently in May 1944 work had started at the Springfield Armory on adapting the M1 Garand to fire in full automatic mode.[26] If the operational research was correct, however, then retaining .30" calibre ammunition for use in both an MMG and a rifle was not necessarily the most effective means by which an infantryman's rate of fire might be increased. This was because the .30'06 produced significant recoil energies which tended to discourage the man from using his rifle. Weapons with smaller calibre bullets could be designed for individual riflemen that would remove the physical discomfort that came from this recoil energy. This would take away the disincentive to shoot, encourage the man to make more use of his firearm and as a result help to

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[21] Marshall, Men Against Fire: the Problem of Battle Command, p. 56.
[22] Ibid., p. 78.
[23] Ibid., p. 76.
[24] Ibid., p. 56.
[25] Ibid., p. 60.
[26] Ezell, The Great Rifle Controversy: Search for the Ultimate Infantry Weapon from World War 2 through Vietnam and Beyond, p. 42.

build up a volume of fire. These were the conclusions of the British Standing Committee on Infantry Weapon Development, but which, as the EM2 advocates were to find, the post-war US Army was unwilling to concede.

For the US Army, Marshall's views were extremely controversial and as a result the technical response to them was restricted by the War Department. Having won a major world war, the infantry was not quite ready to move away from the traditional marksmanship values that, at least on the surface, seemed to have provided a key to victory. Accordingly, whilst new training regimen were put in place to teach 'the fundamentals of precision firing... from many unconventional positions' the Army was not willing to forego, '...the accuracy and functioning associated with a purely semiautomatic rifle' for the sake of increased firepower.[27] Long range marksmanship was the priority as far as the War Department was concerned. Generating greater volumes of fire, whilst important, was a secondary concern.

This point had been explicitly made at a 1946 meeting of the War Department Equipment Board, known as the Stilwell Board after its chairman. During the course of investigations the decision was taken by this board to replace the Garand but maintain the .30" calibre. The new rifle would be lighter than the M1, capable of selective semi-automatic and automatic fire and have the, '...ballistic performance equivalent to that of the present rifle'.[28] The board wanted 'greater firepower – lighter weight' but was not prepared to upset the consensus on .30'06 ammunition to achieve it.[29] Accordingly, the post-war solution hit upon by the Small Arms Section retained the .30" calibre bullet but reduced the length of the cartridge case by making more appropriate use of state-of-the-art propellant. Known as the t65, the problem with this design of ammunition was the same one that John Garand had experienced before the war: how could weapon recoil be minimised without increasing its weight or changing the calibre of the bullet. As they

[27] McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, p. 35.
[28] U.S. War Department, War Department Equipment Board Report, 22nd May 1946, quoted from Ibid., p. 35.
[29] Ezell, The Great Rifle Controversy: Search for the Ultimate Infantry Weapon from World War 2 through Vietnam and Beyond, p. 41.

eventually discovered whilst developing the M14 during the 1950s, what the US Army found was that greater firepower and lighter weight were, '...impractical without a change in ammunition'.[30]

American efforts to undermine the case for the EM2

After the war, the question that the EM2 advocates effectively posed to interested parties in America was related to how far the US Army's marksmanship tradition ought to be defended. With the US Small Arms Section working on the t65, a .30" calibre bullet with many of the same qualities as the .30'06, there appeared to be little appetite among Americans to move to a smaller round. Indeed, given the balance of interests and the strength of support that had emerged in favour of the .30'06 round and the M1 Garand it seemed doubtful that any voices would bubble up within the US Army to argue for the sorts of automatic weapons envisaged by the EM2 advocates. Consequently, the British were unlikely to find obvious allies within the American military establishment who would help them to advance their case for a smaller calibre weapon. This problem was compounded by the fact that the EM2 and the .280" round represented a significant break with the US infantry's past. This not only appeared to undermine American views on marksmanship but also held out the prospect of upsetting the balance of relationships that had existed between the various groups involved in selecting the M1. Accordingly, the EM2 advocates would have to work hard to show how their solution could match US requirements. What they could not anticipate, however, was the level of hostility that their efforts would generate or the degree to which the Americans would go in their efforts to diminish the credibility of the British solution.

When it came to making the case for a change in ammunition the least technical manifestation of the arguments the EM2 advocates were going to have with the US Small Arms Section was related to the name of the British .280" ammunition. In point of fact the British round was actually .276". Given that the officer in charge of the US Small Arms Section, Colonel Rene Studler, had also been proof officer on

[30] Ibid., pp. 42-43.

the Pig Board trials it is clear that the ambition of the EM2 advocates was to avoid any negative connotations associated with the Pedersen .276". The ammunition was not, however, the same, and to drive that point home the British felt it necessary to change the name of their SAA. Thus in October 1947, following a meeting of the advocates, Brigadier Barlow decided to remove any references to the fact and wrote, 'I consider it desirable that the .276" should be referred to henceforth as the .280"'.[31] There was no technical reason for making this decision. It was simply about presentation.

However, by the spring of 1949, the advocates had decided that they would have to do more than make cosmetic changes if they were to persuade the US Small Arms Section that their solution would meet the US Army's needs. In the first instance, the DofA (SA) decided to redesign the ADE's cartridge casing so that the extractor groove complied with US standards.[32] Whilst this might sound trivial, it was in fact an attempt by the British to show that US weapons would not have to have their own extractor mechanism replaced if they were to be re-chambered to fire British ammunition. Consequently, a simple alteration in cartridge design would mean fewer changes to US manufacturing tools, producing considerable savings in both time and money.

Secondly, the advocates developed a rifle grenade to meet US Army requirements. The DInf had already decided that the British Army would not need a rifle grenade, as an infantry mortar would fulfil the role.[33] The Americans, however, viewed a rifle grenade as essential. This prompted Brigadier Barlow to conclude that, 'if we cannot prove that we can fire grenades by means of a launcher with our weapons and ammunition we shall not stand a chance of convincing the USA that our .280"

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[31] Memo from Brigadier Barlow, 'Change of Nomenclature of .276" Round', 29th October 1947, Ammo .280" – 1 .280"in (7mm) Ammunition 82 Series File, MOD Pattern Room Archive.
[32] Letter from DofA (SA) to DOF, 13th May 1949, Ammo .280" – 1 .280"in (7mm) Ammunition 82 Series File, MOD Pattern Room Archive.
[33] In discussions during early 1947 it was also made clear that a rifle grenade might compromise the ability of the ADE to develop one rifle with two roles as the additional stress of firing a rifle grenade could compromise the design of the IPW. For GS requirements see, 'Future Requirements of Small Arms for the Army', Memorandum by the DMT, 19th April 1947, WO 32/10515, NA.

calibre solution is the right one'.[34] In relation to both the cartridge case and the rifle grenade the advocates were clearly looking to develop equipment characteristics that would appeal to American decision makers.

These efforts aside, it was becoming clear during the course of late 1948 and early 1949 that Colonel Studler was trying to railroad through the US Army a production order for a prototype rifle, called the t25, in the hope of presenting the EM2 advocates with a *fait accompli*.[35] These efforts had culminated with what British intelligence believed to be the direct lobbying of General Bradley, then Army Chief of Staff, in an attempt to persuade the US Army to order 5000 t25s.[36] If successful then Studler would have shown the British that the US Army was committed to an American design of firearm. That he was not can partly be explained by the intervention of the BJSM who wrote directly to Bradley asking him not to place an order. Thus, unable to deliver a *fait accompli*, Studler was forced into asking for a delay to US/UK trials, scheduled for 1949, so that his Small Arms Section could have more time to prepare the t25.[37] Interestingly the exchange had also revealed, according to British liaison officers, that the Army Chief of Staff was apparently not well disposed towards a fully automatic firearm and thought the .280" ammunition rather small.[38]

Postponing the trials in an effort to bring the t25 up to an appropriate developmental level was, however, just one area where the Americans sought to find advantage over the EM2 advocates. By making the terms of the trials as difficult as possible, Studler also hoped to undermine the British before they had even completed their work. With the DCIGS keen to replace the No.4 Rifle, it was important for the advocates to have an idea about when the trials would take place and what they

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[34] Operation Niblick Stage III, Memo from Brigadier Barlow DofA (SA), 25th May 1949, Ammo .280" – 3 .280"in (7mm) Ammunition, MOD Pattern Room Archive.
[35] The t25 was a prototype weapon that fired the t65 .30" round. Correspondence between the BJSM and DGofA, 9th, 11th and 17th November 1948, WO 185/242, NA.
[36] Letter from BJSM to DofA (SA), 17th May 1949, WO 185/242, NA.
[37] Ibid.
[38] Ibid.

would consist of.[39] The Americans, in contrast, were happy to stretch out the length of time it took to reach agreement both in relation to defining the test plan and in conducting the tests themselves.

In the first iteration of the test plan it was envisaged that the technical would precede the user trials. The technical trials were designed to verify the physical characteristics of the rifle such as the muzzle velocity or the number of rounds that could be fired before the weapon failed. User trials, in contrast, gave soldiers the chance to fire the weapon on a range, following a test plan that investigated matters such as ease of use, handiness, accuracy or controllability. Usually the technical preceded the user tests so that weapons that did not meet the specifications could be ruled out. However, with the Aberdeen Proving Ground stating that it needed 385 working days just to complete the technical trials the British soon protested that it would take too long before a recommendation would be made.[40] Not only would this hamper efforts by the War Office to replace the No.4 Rifle but it also prevented the ADE from deploying its resources on other projects. Eventually the two sides agreed that it would save time if the technical and user trials were run in parallel. The trade off was that the British had to agree to submit fewer weapons for trial so that the tests could be completed more quickly. Accordingly, the EM2 advocates decided to drop the EM1 from the test plan so that enough time would be available to test the EM2 and the American t25.[41]

In addition to the debates about when and how long the trials would take, the Americans also went to some lengths to amend the procedures and terms of

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[39] Letter from DGofA to CS(M), Comparative Tests of New US and UK Small Arms Ammunition and Rifles, 14th April 1949, WO 185/242, NA.

[40] Letter from DGofA to CEAD, 'Comparative tests of new SAA and Light Rifles in USA', 5th January 1950, 340 (200) EM2 S/L Rifles Box 1, MOD Pattern Room Archive.

[41] It was decided to drop the EM1 because it was not as at an advanced a stage of development as the EM2. This can partly be explained by the fact that there was only one designer working on the weapon. It was also decided at this stage to drop another rifle developed by BSA and only submit the FN .280" and EM2 for trials in the States. Regarding the Belgian company's weapon see section on the FN later in this chapter. Letter from DGofA to CEAD, 'Comparative tests of new SAA and Light Rifles in USA', 5th January 1950, and for references about the EM1's under-staffing see letter from DofA (SA) to A/CEAD (SA), 16th December 1949, 340 (200) EM2 S/L Rifles Box 1, MOD Pattern Room Archive.

reference for both the Working Committee overseeing the technical trials and the US Army Equipment Board managing the user trials. With regards to the technical trials Studler rejected the claim that the US was committed by the mutual Agreement on Comparative Tests of Light Rifles and Ammunition signed in October 1949 to make recommendations directly to the Pentagon's standardisation officers.[42] Instead he wanted the results of the technical trials to be sent to the Army Equipment Board where additional comments would be allowed.[43] The British complained that this amounted to asking the layman to discuss matters of technical detail but it might not have constituted an unacceptable condition except for the fact that Colonel Studler was also trying to define the .280" out of the user trial's remit. The US Army Equipment Board had initially been instructed

> To review, and, where necessary, revise the War Department Equipment Board Report (1946) [i.e. the report of the Stilwell Board] for the purpose of establishing the principal equipment requirements of the army to serve as a guide to research and development.[44]

By March 1950, however, this had been changed to read, 'A lightweight calibre .30" rifle is required which, with minor modifications, is capable of replacing all present shoulder fired small arms including the BAR'.[45] If this clause had been allowed to remain then the .280" would have immediately failed the criteria. As it was the BJSM's liaison officers were quick to spot the changes and the original wording was put back. Increasingly it seemed the Americans were prepared to adopt underhand tactics in order to get their own way, a situation that led Brigadier Barlow to comment in a draft letter that

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[42] Letter from BJSM to DInf, 18th September 1950, 340 (200) EM2 S/L Rifles Box 1, MOD Pattern Room Archive.
[43] Ibid.
[44] Report of US Army Equipment Board, 8th March 1950, letter from DofA (SA) to DGofA, 28th April 1950, WO 185/242, NA.
[45] Ibid.

> ...this is a back door approach to queer the pitch, and get something on the records on a high enough level in the Pentagon to ensure that our proposals are stillborn, even though the test results may be distinctly favourable.[46]

But it was not as if the trials were implemented with impartiality in mind. For the fact of the matter was that both sides were guilty of trying to distort the tests in order to show how their respective weapon was superior. The best example of this is related to the rifle grenade investigations. As already stated, Britain had no need for a rifle grenade but the ADE weapons were modified to account for an American requirement. In April 1950 the EM2 was subsequently tested at Fort Benning using an M.11.A.2 grenade. The ADE, however, had optimised the EM2 to fire the wartime US M.9.A.1, as agreed in the test plan. When the British weapon suffered significant damage it emerged in the ensuing investigations conducted by the ADE that the Americans had deliberately changed grenades.[47] As intended, this kind of trick in combination with all the other issues shaping the perceptions of the .280" round could severely undermine the impression the EM2 advocates were trying to create.

The science of wound ballistics

Given the vehement defence of their respective solutions it might have been expected that a more objective analysis of the data could help to arbitrate between the two sides. In many ways, this was the function of the technical trials. However, even at this level it proved to be difficult to resolve the different opinions of the Americans and the British. In particular, it became evident that the science of wound ballistics could not produce a conclusive answer that satisfied all the actors. The source of this problem lay with how scientists on either side of the Atlantic understood wounding power. These differences in turn conditioned the way results

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[46] Draft letter from DofA (SA) to DGofA titled, 'Report of US Army Equipment Board, 8th March 1950, WO 185/242, NA.
[47] Letter from A/CEAD to DofA (SA), 28th April 1950, 340 (200) EM2 S/L Rifles Box 1, MOD Pattern Room Archive.

were interpreted and, as will become clear, left both sides believing what they preferred to believe.

Since before the First World War ordnance officials around the world and especially in the United States worked from the assumption that in order to achieve incapacitating results, small arms ammunition had to strike a target with at least 58ft/lbs of kinetic energy.[48] Although derived from investigations into small arms ammunition, the figure was based in inadequate and fragmentary research conducted in Europe and had no methodologically sound reason for being used.[49] In contrast, early wartime studies undertaken for the Ministry of Home Security by Professor Zuckerman and Drs Delisle Burns and Black indicated that the 58ft/lbs criterion did not provide a sufficient basis for explaining wounding.[50] Rather than attribute incapacitation to the amount of energy that could be transferred from the projectile into the victim, Zuckerman and his colleagues sought to derive an explanation for wounding based on the actual battlefield data available to them. As evidence collected in the First World War was incomplete or lacked internal consistency the most obvious source of casualty statistics had to come from investigations undertaken after September 1939.[51] Accordingly, a great deal of effort was put into carrying out casualty surveys following German air raids on British cities. These examinations revealed that small shell splinters caused, '…dangerous, and even fatal, wounds out of all proportion to their size'.[52]

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[48] See, 'A review of the criteria of wounding power in common use' by Dr B. Delisle Burns and Dr P. L. Krohn, Ministry of Aircraft Production, Oxford Research Unit, Scientific and Technical Memoranda No.C.3/45, 11th October 1945, p. 1, SZ/OEMU/47/19/31, Zuckerman Papers, University of East Anglia (UEA).
[49] Ibid.
[50] Early glimpses into the research being conducted by Zuckerman, Delisle Burns and Black (whilst working for the Anatomy Department of the Oxford Extramural Research Unit) can be found in S. Zuckerman, A. N. Black and D. D. Burns, 'An Experimental Study of the Wounding Mechanism of High Velocity Missiles', British Medical Journal, Vol: ii, (1941). An introduction to Zuckerman's work can be found in S. Zuckerman, From Apes to Warlords: the Autobiography (1904-1946) of Solly Zuckerman, (London: Collins, 1988), pp. 113-130.
[51] See, 'The Wounding Power of Small Bomb and Shell Fragments' by B. Delisle Burns and S. Zuckerman, RC350, October 1942, Appendix II, HO 195/13/350, NA.
[52] Ibid p. 4.

Apart from the data generated from surveys of Blitz casualties, the only other reliable evidence available, at that time, had been derived from analysis undertaken by Professor Zuckerman of 220 service casualties taken from Flanders and France during 1940. What made this interesting was that of the 985 splinters found in the bodies of the personnel concerned, for every splinter between 2cm and 4cm there were approximately four splinters of between 1cm and 2cm, seven between 0.5 and 1cm and 43 below 0.5cm.[53] As some of these sub-0.5cm splinters had produced highly incapacitating results, the 58ft/lbs criterion seemed to be open to some doubt. Specifically, the 58ft/lbs criterion implied that for munitions with an average burst velocity of 2000fps, all fragments weighing less than 400mg were harmless.[54] This calculation was made possible because two values in the equation for kinetic energy were known. Kinetic Energy is defined as half mass multiplied by the square of velocity or

$$KE = \frac{1}{2}mv^2$$

Rearranging the equation to determine the mass gives results in

$$m=2KE/v^2$$

Based on the assumption that it took 58ft/lbs to incapacitate and that a fragment from a bomb blast struck the target at 2000fps, the mass of a projectile had to be greater than 0.014oz (i.e. 1/70[th] of an oz or 400mg). However, it had been observed that a man could be severely wounded whilst standing 3 metres away from the blast of a 50kg bomb by a fragment weighing less than 10milligrams.[55] It appeared that the 58ft/lbs criterion only served to make a whole swathe of battlefield casualties theoretically impossible. Thus, given that the data did not support the 'all or nothing' notion that it took a minimum of 58ft/lbs of kinetic energy to cause incapacitation, more had to be done to properly explain wounding.

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[53] Ibid., p. 4.
[54] See, 'A review of the criteria of wounding power in common use', p. 4.
[55] See, 'The Wounding Power of Small Bomb and Shell Fragments', p. 4.

In contrast to the assumptions that underpinned the 58ft/lbs criterion, the analysis undertaken by Zuckerman et al. showed a correlation between the striking velocity of the splinter and its ability to produce what surgeons defined as incapacitation.[56] In order to substantiate this finding the British scientists started by ascertaining the relative vulnerability of various parts of the body based on the field data they had available. They then asked a number of surgeons to define what types of wound would incapacitate and in particular how far the projectile would need to penetrate into the various parts of the body, such that it would force the victim to need medical treatment. As a result it became clear that even a small splinter striking and penetrating the skull cap could be fatal whereas it might take the perforation of the breast plate before incapacitation might occur when a fragment struck the thorax and abdomen. Incapacitation in this context was not a hard and fast rule such that for any injury a certain amount of time would be needed for recovery. Instead it meant that, '...sooner or later the casualty would be out of action for a period in which medical treatment would be necessary'.[57]

The next step was to ascertain the critical striking velocity a splinter would need to achieve if it was to meet the incapacitation criteria provided by the surgeons. Two observations could be reached from this investigation. One was that the required velocities would change depending on which part of the anatomy was struck. The other was that the momentum lost by a missile travelling through the body was proportional to the degree of tissue destruction. As a result of this analysis it became clear that, for example, a man's head when protected by a helmet would need to be struck by a fragment with a velocity of at least 2850fps. In contrast a projectile striking an unprotected abdomen only needed an impact velocity of 1000fps.[58] Further consideration was then given to oblique impacts, strikes to military equipment and clothing. After having completed all this, it then became possible, with the use of some statistical analysis, to show that for a certain weight of splinter

[56] The data for what follows can be found in Ibid., p. 4.
[57] Ibid., p. 7.
[58] Ibid., p. 2.

- the example used by Zuckerman et al. was 52milligrams - the probability of hospitalisation went up as the velocity of the projectile increased.

The work by the British scientists showed that the 58ft/lbs criterion was not sophisticated enough to explain wounding. Instead they had demonstrated that there was a probabilistic relationship between the need for medical treatment and the impact velocity of the missile. American ordnance officials wedded to the notion that kinetic energy was the best index of wounding remained to be convinced. Accordingly a Princeton group of academics led by E. Newton Harvey was asked in September 1943 by the US Army Medical Corps to take a closer look at the work undertaken by Zuckerman et al.[59] Using similar equipment to their British counterparts, what Newton Harvey et al. observed was that a bullet travelling at high velocity created a permanent and a temporary cavity within the victim. Photographs showed that the temporary cavity expanded and contracted several times along the path traversed by the missile before collapsing completely. The permanent cavity remained even after the missile had passed through the body. Even though at first sight tissue destruction seemed limited to the permanent track, in fact the trauma to the body was considerably more widespread. Unconvinced by Zuckerman's claim that there was a relationship between a projectile's loss of momentum inside the body and the proportion of tissue destruction, the Princeton Group reported that, 'Study and measurement of temporary [wound] cavities show that the total volume of the cavity is proportional to the energy delivered by the missile'. [60] Whilst research had yet to establish the exact value of kinetic energy required for incapacitation, the Princeton Group left many American scientists believing that energy provided a rough estimate of the wounding power of small missiles.[61] Although Zuckerman was still sceptical about the kinetic energy argument,[62] by the

[59] Prokosch, The Technology of Killing: a Military and Political History of Anti-personnel Weapons, p. 17.
[60] Ibid., p. 20.
[61] See, 'Memorandum for Dr. J. F. Fulton on the use of 58ft/lbs as a Criterion of Incapacitation', 16th March 1945, SZ/OEMU/44/17/79, Zuckerman Papers, UEA.
[62] Letter from Zuckerman to Brigadier Leitch, 4th October 1946, SZ/OEMU/46/5/4, Zuckerman Papers, UEA.

end of the war, with little research having been completed to establish the precise value of energy required, the 58ft/lbs criterion retained its place in the United States as an accepted estimation for wounding power.[63]

The American perspective might not have been such a problem bar the fact that in their negotiations with the War Office, the EM2 advocates had committed themselves to matching the striking energy of the .30'06 at 2000 yards.[64] As stated in the previous chapter, this meant that a British designed bullet would need to hit the target with 87.57ft/lbs.[65] According to Zuckerman's wartime research this was massively overpowered. However, by accepting the need to match the kinetic energy of the .30'06 at 2000 yards the EM2 advocates acknowledged the possibility that their ammunition would be subject to American interpretations of lethality. By March 1949, in line with the Zuckerman criterion, the British believed that the .280" could deliver an appropriate level of striking energy sufficient to produce incapacitation.[66] What was less clear was whether the round could precisely match the 87.57ft/lbs generated by the .30'06 at 2000 yards. If the Americans were flexible and viewed lethality in terms defined by Zuckerman then the advocates stood a chance of surviving the technical trials. If they insisted on the kinetic energy criterion and the .280" failed the test, then the EM2 advocates would have to rely on evidence provided by the user trials – being conducted at the same time – in order to demonstrate the wider benefits of their solution.

Unfortunately for the EM2 advocates the trials at the Aberdeen Proving Ground revealed that American ballisticians defined lethality in terms of kinetic energy and

[63] See, 'Memorandum for Dr. J. F. Fulton on the use of 58ft/lbs as a Criterion of Incapacitation'.
[64] Specifically it had to be a .30'06 155 grain bullet. See DofA (SA) Directive on SA Weapon and Ammunition Development Programme for the Future, 18th September 1947, Letter from DofA (SA) to ADE, DGofA, and DOF. Ammo .280" – 3 .280"in (7mm) Ammunition, MOD Pattern Room Archive.
[65] See, History of the .280", the ADE SAA Development Diary, entry of 5th November 1948, Ammo .280" – 3 .280"in (7mm) Ammunition. MOD Pattern Room Archive. See Chapter five, note 35.
[66] The correspondence is incomplete. However it is clear that the DofA (SA) believed this to be the case and was working to convince DInf likewise, 29th May 1949. Ammo .280 – 1 .280" (7mm) Ammunition 82 Series File, MOD Pattern Room Archive; see also DofA (SA) Directive on SA Weapon and Ammunition Development Programme for the Future, 18th September 1947, AMM 3 – 3 .280" (7mm) Ammunition, MOD Pattern Room Archive.

not the relationship between bullet velocity and the probability of hospitalisation. As a result the Working Committee overseeing the technical trials was of the opinion that the t65 round was considerably more lethal than the .280".[67] In response, the Ministry of Supply sent Professor Zuckerman out to the United States to argue the case.[68] In the subsequent discussions, the Americans agreed that velocity was an important characteristic in ammunition design but pointed out that the .280" round had a low muzzle velocity when compared to the .30" t65.[69]

The underlying reason for this was that the round produced by the EM2 advocates had been designed for short range engagements. According to the requirements laid down by the DInf in 1944, the 2000 yard requirement was considered to be a stretch target.[70] The focus was on producing a rimless round suitable for combat below 800 yards.[71] However, in the context of these Anglo-American comparative trials, it is what Brigadier Barlow did not say to his counterparts in the US Ordnance Corps that really reveals the problem facing the EM2 advocates. If Barlow had stated that the Ideal Calibre Panel had been set up to investigate ammunition appropriate for engagements at closer range then it would have been impossible to claim that the .280" ammunition satisfied US Army as well as British infantry requirements. This was not something that Barlow could admit. To do so would have broken the consensus between the EM2 advocates and the War Office on how to achieve standardisation. To do otherwise was to let the Americans come to the conclusion that the .280" ammunition had inadequate velocity and was therefore insufficiently lethal.

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[67] Dr C. M. Herget of the Edgewood Chemical Center and Dr H. P. Robertson of the US Weapons Systems Evaluation Group, '.280 inch SAA and .30 t65 type', memo by Brigadier Barlow, 27th March 1951, WO 185/242, NA.
[68] Ibid.
[69] Aberdeen Proving Ground test results concluded that .280" achieved an average velocity of 2211 fps at the beginning of the test and 2172 fps at its end. The t65 in contrast achieved 2737 fps and 2754 fps respectively, Dugelby, EM-2 Concept and Design: a Rifle Ahead of its Time, p. 119.
[70] See Chapter five, notes 33 and 34.
[71] General Staff Policy Statement No.3, 27th November 1944, WO 32/10515, NA.

Given their definition of lethality it is no wonder that US ballisticians remained unsympathetic to the British SAA. The Americans were ill-disposed to a calibre of ammunition below .30" because they believed that infantrymen still required a round that enabled them to engage with targets out to 2000 yards. According to the US Ordnance Corps this meant striking a target with at least 58ft/lbs but as much as 87.57ft/lbs of kinetic energy if the .30'06 round was the benchmark for lethality. If the Zuckerman criterion had been accepted by the Americans then the .280" round might have been sufficiently lethal. However, the underlying problem for the EM2 advocates was that they were unable to state their different conception of the battlefield because they had agreed with the DCIGS that they would match the striking energy of the .30'06 at 2000 yards, even though, as far as the EM2 advocates were concerned, this was overkill. As stated in the previous chapter the advocates believed that infantry engagements typically occurred at ranges below 300 yards.[72] With the EM2 advocates unable to discuss their view of infantry combat because of their agreement with the War Office on standardisation, the technical data appeared in American eyes to confirm their opinion that small calibre ammunition was insufficiently powerful.

Nevertheless it did not follow that the Americans could simply insist that the British accept the view of the Working Committee overseeing the technical trials. Bearing in mind that sovereign governments had the ultimate say over what weapons their national armies would adopt the British could choose not to accept the results of the technical trials. However, in the context of NATO standardisation, if enough nations agreed with the American position then there would be the chance that the British would be forced to reconsider their decision. The active involvement of the Canadians and the French held out such a possibility and it is to the attitudes of these two countries that this chapter now turns.

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[72] See Chapter five, note 49.

The Canadians and the French

The Canadian interest in the Anglo-American small arms debate stretched back to 1946 when the DCIGS had asked Canadian officials what they thought about the British Army adopting the US .30'06 round. When the DCIGS changed his mind the Canadian military were subsequently asked for help with experimental facilities so that the British could speed up the development of the .280" round.[73] In addition, the Canadians were directly involved in the post-war 'America, Britain, Canada' (ABC) agreements related to small arms standardisation and acted as the weapon handlers and observers to the 1950 SAA and rifle trials in the US.[74] In contrast, the French Government's involvement in the post-war small arms debates was quite minimal until it was asked by the United States to attend a meeting of the NATO powers to discuss standardisation in August 1951. As this meeting gave France and Canada an important role in upsetting British plans this next section is concerned with exploring some of the reasons why the French and Canadian Governments took the position that they did.

Whilst the trials were underway there was some hope that agreement between the ABC nations could happen amicably. When the trials ended in September 1950, however, the Canadian position started to become more difficult. The immediate cause of this was the inconclusive results of the comparative trials. Whereas the technical tests had indicated that the .280" round was not sufficiently lethal, the user trials appeared to be considerably more encouraging for the British. Indeed, as far as Brigadier Barlow was concerned, the US Army Equipment Board had concluded that neither the t65 nor the .280" were satisfactory in their current incarnations but that of the two submitted the British SAA was preferred.[75]

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[73] Letter from Brigadier Barlow to Colonel Galbraith, 16th December 1951; and letter from Colonel Galbraith to Brigadier Barlow, 9th January 1951, both found in RG24 Box 3502, Library and Archives Canada (LAC).
[74] 'Summary of Discussion Concerning Standardisation of Infantry Weapons', 11th & 12th October 1949, RG24 Box 3502, LAC.
[75] '.280" SAA and .30" t65 type', Brigadier Barlow, 27th March 1951, WO 185/242, NA.

The Americans, in contrast, were considerably less happy about the direction the US Army Equipment Board was headed. Accordingly, in December, whilst ostensibly still examining the details of the joint comparative trials, the Americans asked the NATO Standing Group to consider standardising the M2 .30'06 SAA for all NATO countries.[76] This was followed up by communications with the BJSM which stated that, 'The future US round will be the .30" calibre t65'.[77] By all accounts the Americans had decided to go it alone. As a result, the UK's military and technical establishments, in March 1951, felt the need to consider the question of adopting the EM2. Apart from the shenanigans during the trials, the fact that the US had apparently ignored the results of their own Army Equipment Board left the British feeling they had every right to decide what they wanted to do without concern for standardisation. The matter was consequently accelerated through the War Office and ultimately presented for consideration to the Chiefs of Staff and the Cabinet Defence Committee.[78] With all in agreement Emmanuel Shinwell announced to the House of Commons on the 25th April 1951 the UK's decision to adopt the EM2 as the Rifle No.9 Mk.I.[79] At this point, what were previously the private and somewhat abstract discussions of a discreet technical community became the reified stuff of debate on the floor of the House of Commons. Shinwell's announcement finally polarised the split within the trans-Atlantic community, bringing Winston Churchill out in favour of the American position.[80]

For the Canadians, the EM2 represented a difficult proposition. Canada had fought the Second World War as a Dominion power but with the fall of the Axis, politicians were seeking to re-position the country in order to help bring economic and military stability to the world. Key to this was Canada's pursuit of a dual strategy to build

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[76] Letter from BJSM to DCIGS, 22nd January 1951, Ammo .280" – 1 .280"in (7mm) Ammunition 82 Series File, MOD Pattern Room Archive.
[77] Letter from BJSM to DofA (SA), 9th February 1951, WO 185/244, NA.
[78] The Adoption of the New Small Arms Ammunition and Weapon into the British Armed Forces, Note by the Chiefs of Staff to the Cabinet Defence Committee, 16th March 1951, WO 185/244, NA.
[79] Parliamentary Debates (Hansard), House of Commons, Oral Answers, 25th April 1951, col. 378.
[80] Ibid.

security arrangements and maintain export markets with both America and the UK.[81] Ideally trans-Atlantic harmony would give Canada the greatest opportunity to maximise her export potential and create the ideal conditions for a full change of the country's economy from war to peace footing. Whilst the EM2 represented only a minor piece of that story, for the Canadians it was true to say that any disharmony between the UK and US on something as simple as a rifle would not bode well for standardisation of all trans-Atlantic military equipment.[82] A failure on this would mean that the Canadian Government would be required to establish more industrial capacity catering for differing US and UK equipment needs with a consequent decrease in financial return. This was something the Canadian Government would prefer not to do. Achieving agreement on the rifle issue was, therefore, the first step to getting rid of the perennial Canadian problem of using American machine tools to manufacture British equipment. This was a problem because British manufacturing standards were different from those in America and this complicated the manufacturing process.[83] The question of military utility was, as far as the Canadian Government was concerned, of secondary importance. If the Americans refused to accept the EM2, then Canada would also prefer an alternative solution.

Given their difficult geopolitical position, it was the Canadians who first sought a reconciliation of the respective positions by calling for a ministerial conference to be held in Washington in August 1951 to discuss the issue.[84] Britain's Minister of Defence, Emmanuel Shinwell, was cautious about accepting.[85] The reason for this lack of British enthusiasm appears to have been the suspicion that the Americans were going to use the summit as an opportunity for gathering support for their t65 SAA.

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[81] H. MacKenzie, 'The ABCs of Canada's International Economic Relations, 1945-1951', in Canada and the Early Cold War, 1943-1957, G. Donaghy (ed.), (Ottawa: Department of Foreign Affairs and International Trade, 1998), p. 217.
[82] Letter from Canadian Minister of Defence, Mr Brooke Claxton to UK Minister of Defence, Mr Emmanuel Shinwell, 22nd June 1951, CAB 21/3465, NA.
[83] Ibid.
[84] Telegram from Canadian Minister of Defence, Mr Brooke Claxton, to UK Minister of Defence, Emmanuel Shinwell, 21st June 1951, CAB 21/3465, NA.
[85] Ministry of Defence to BJSM, 5th July 1951, CAB 21/3465, NA.

In this respect Shinwell's fears were well founded. For whilst the Canadian Minister of Defence had suggested a meeting between the ABC powers, the American Secretary of State for Defense, General Marshall, made sure that the French were aware of the conference and held out the possibility of an invitation.[86] The French had previously shown no interest in the rifle debate, primarily because they had not been party to the early agreements on equipment standardisation, but they were clearly more than happy to attend following Marshall's overtures. French involvement had not been automatic. It was only with the establishment of NATO in 1949, that they had a legitimate pretext for being present. Their attendance, however, presented the British with a difficult political problem. The French were clearly reliant on US small arms whilst they were trying to recover control over their former colonies and were unlikely to bite the hand that fed them and argue in favour of the UK proposals.[87] The British delegation was, therefore, at a distinct disadvantage as the decision to adopt the EM2 was likely to be opposed by the other three powers attending the meeting.

For the British the August meeting did not go well. As Shinwell no doubt predicted, the French and Americans opposed the British decision whilst the Canadians stated that they were stuck in a difficult position which they increasingly found hard to maintain.[88] Mr Brooke Claxton, the Canadian Minister of Defence, made the point that they were caught between the UK and the United States and that they were being forced to chose between the two nations. They could choose one standard of SAA and firearm but that would leave the NATO powers at a disadvantage as Canada could not manufacture both types of ordnance. At a deeper level, Mr Brooke Claxton questioned the whole standardisation programme arguing that the US and UK were failing to make transparent and compatible decisions. As a result it

[86] Telegram from BJSM to Ministry of Defence, 23rd June 1951, CAB 21/3465, NA
[87] Ibid.
[88] Précis of the Defence Ministers' Conference in Washington, 2nd to 3rd August 1951, CAB 21/3465, NA.

was extremely difficult for Canada to organise its own equipment procurement and programme of manufacture.[89]

The French and the Americans, in contrast, were considerably more forthcoming in stating their views of the British decision. Whilst the French had not seen any technical information on the .280" round they were of the opinion that the stopping power of the ADE ammunition was likely to be inadequate. They therefore believed that NATO ought to adopt the .30" calibre and made it clear that France would support the US in questions relating to small arms.[90] It was consequently left to the Americans to outline the technical reasons for rejecting the joint comparative trials in 1950 by stating, 'That none of the test rifles, or ammunition, was suitable or acceptable, and none could be considered as a replacement for the popular battle tested M1'.[91] Accordingly they argued that the only possible solution was that they adopt the t65 round and standardise it across NATO.[92] The conclusion eventually forced on Shinwell was to refer the matter to a Working Party of the NATO Standing Group on Standardisation.[93]

This was bad news enough for the British delegation but worse was to come. Upon his return home Brigadier Barlow performed some analysis of the conference and found that the US Small Arms Section, and Colonel Studler in particular, had wilfully used data that described an older prototype version of the UK's .280" ammunition.[94] In the course of a US presentation that made use of many charts and graphs, it was difficult to spot the error. In fact the ADE had been working on

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[89] Ibid. Provided with a variety of kit from Canada, the US and the UK, soldiers in the Canadian Army fighting in Korea were experiencing problems with unsuitable equipment and standardised logistics on a day to day basis. See Watson, Far Eastern Tour: the experiences of the Canadian Infantry in Korea, 1950-53, pp. 96-129.
[90] Report on the Small Arms Conference held in the USA on 2nd and 3rd August 1951, CAB 21/3465, NA.
[91] Ibid.
[92] Ibid.
[93] Text of Communiqué following conference on the Standardisation of Weapons, 3rd August 1951, found in 'Adoption of the New Small Arms Ammunition and Weapons by the British Armed Forces, memorandum by the Minister of Defence, Cabinet Defence Committee, 12th September 1951, CAB 21/3465, NA.
[94] Précis of the Defence Ministers' Conference in Washington.

increasing the velocity of the .280" ammunition, a fact that had not been alluded to in the conference, and which the Americans chose to ignore. Instead they preferred to use the older data in their efforts to make a case against the British design solution. Clearly both sides were a long way from coming to any sort of agreement.

Unfortunately for the EM2 advocates the decision to adopt the EM2 had also led Winston Churchill, the leader of the opposition, into the fray. Churchill could now openly voice his own views in the House of Commons, undoubtedly leading Shinwell to agree to refer the British decision to the NATO Standing Group in order to show that he had achieved something by his visit to the United States.[95] It was not, however, the view of the Standing Group that forced a change in War Office policy; rather it was the Conservative Party's re-election in October 1951 that was the final turning point for the EM2. For what the NATO Standing Group had decided effectively left it open to the British to stick by their decision should they so wish. This was because the Group only agreed a list of military characteristics that the NATO powers, with the notable exception of Britain, wanted to see from their SAA. In the future a standard round ought to more closely resemble the .30" t65 than the .280" ADE round.[96] However, the Canadian delegation also indicated, on the basis of the Standing Group's own SAA trials, that the UK, '...be urged to continue work on the .280"...' as, '...it shows such promise...'.[97] The British, it seemed, had been given enough permission to stick to their decision.

Churchill and the Conservative Government

Unfortunately for the EM2 advocates the situation changed with the election of the Conservative Government on the 25th October 1951. Churchill was suspicious of the ADE's design of rifle and had been arguing against the Labour Government's decision since April. In the first instance it seems likely that his counter arguments were not based on anything more than an instinct for creating a political debate and

[95] The rifle question surfaced in the House of Commons a further five times after April 25th and before the General Election of October 1951, see Hansard Parliamentary Debates, 1951.
[96] Appendix Standardisation of Small Arms Ammunition – A Report by a Working Party to the Standing Group North Atlantic Military Committee, 5th October 1951, CAB 21/3465, NA.
[97] Ibid.

his active interest in firearms. Over time, as he gathered information from a variety of sources, Churchill put himself in a stronger position to object to the Labour decision. His objections were twofold. Firstly he was not convinced by the arguments concerning the need for increased rates of fire. Logistically speaking, Churchill was of the opinion that automatic firearms were impracticable given the strains on the supply chain during war. Secondly, he viewed standardised equipment as an essential pre-requisite to gaining emergency wartime access to the North American manufacturing pool. This section explores these views, exposing the mechanisms by which Churchill finally forced the CIGS to back down.

Churchill's initial objection to the EM2 stemmed from his belief that there was no advantage to be gained from increasing the number of rounds that an infantryman could fire per minute.[98] This view remained with him throughout his opposition to the EM2 and quickly surfaced once he was re-elected Prime Minister. Indeed, one of the first things the new PM did was to write a brief note to the Chiefs of Staff stating his personal view on the EM2. Churchill wrote

> There is no doubt that the .280" is a far better rifle than the .303". It may well be technically the best so far designed. The rate of fire is not however important or usually an advantage. The existing rifles can fire away more ammunition in ten minutes than the soldiers can carry. Indeed the practical problem has been, and I believe still is to husband the use of ammunition by the forward troops.[99]

This contention was the exact opposite to that held by all DInfs since 1944. Moreover, the CIGS and a growing number of staff officers were also coming to the conclusion that, in the face of an increased threat to Europe from the Soviet Union, it was absolutely necessary to replace the bolt action No.4 with a weapon with

[98] Parliamentary Debates (Hansard), House of Commons, Oral Answers, 25th April 1951, column. 378.
[99] Note by the Prime Minister, 12th November 1951, PREM 11/854, NA.

increased rates of fire.[100] General Harding, commanding the British Army on the Rhine (BAOR), summed it up when he stated that

> One of the main objectives must be to conserve manpower by making the maximum use of killing weapons, artillery, anti-tank guns, automatics and mines. The ammunition problem can be met and solved, indeed economy of material should come second in priority to economy in manpower.[101]

If this was becoming the received view of the General Staff then Emmanuel Shinwell was doing nothing more than agreeing to the wishes of the professionals advising him.[102]

Thus it seems remarkable that Churchill believed it necessary to intervene and put a brake on the EM2's development given the weight of military opinion in favour of its adoption. If the new Prime Minister had taken note of the arguments put forward by the EM2 advocates then he would have seen that the .280" ammunition had no logistical implications. This was because it was in fact both lighter and smaller in size than the existing .303" round.[103] Indeed, the ADE had specifically explored this issue with a number of documents designed to illustrate the logistical advantages of

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[100] The DCIGS had asked for intelligence information on Russian small arms in July 1951. This had been provided by the British small arms community who, it seems, used it as an opportunity to make the point that the .280" round was far superior to the equivalent weapons available to the Red Army, see 'Russian Equipment – Comparison of British and Russian Rifles and Ammunition', 18th July 1951, WO 185/244, NA. Letter from Anthony Head to Winston Churchill, 19th June 1951, Churchill College Archives, CHUR 2/34.

[101] Letter from General John Harding C-in-C, BAOR to the Under Secretary of State for War, 4th October 1951, WO 291/1169, NA.

[102] Letter from Emmanuel Shinwell to Sir Alfred Herbert K.B.E, 25th June 1951, CAB 21/3465, NA.

[103] A clear indication of the Prime Minister's distrust of the firepower argument is illustrated by the following story. Churchill met with Brigadier Barlow, Noel Kent Lemon and the Deputy DInf Brigadier Gordon at Chequers to fire the EM2 and t25 on 24th November 1951. When it was pointed out that the British infantryman had been expected to use .303" ammunition for 50 years and that it was time for it to be replaced, 'Mr Churchill replied, with a smile, that we had used the long bow for very much longer than 50 years'. See 'Brief Record of Demonstration of the .280" and EM2 at Kimble Range near Chequers to the Prime Minister on Saturday 24th November', 29th November 1951, WO 185/320, NA.

.280" over .303", and t65 ammunition.[104] This had shown, for example, that .280" calibre allowed 828,000 more rounds to be carried by a British infantry division without any increase in transport above that required to carry the .303" cartridge.[105] If there was a logistical debate to be had, then the real issue related to the fact that the US Army had the luxury of motor transport to carry their troops and supplies to the front lines in quantities that the British did not. They could, therefore, afford to transport a larger more powerful calibre round without causing significant strain to the supply chain.[106] In contrast the British infantryman needed a smaller, less weighty round as they would be required to carry it to the front lines in their webbing. As one commentator put it, 'The U.S. infantry lives off or near to and move in jeeps, peeps and lorries. The British infantry's mobility is the mobility of the man on his feet. This fundamentally different attitude to infantry is at the root of the different approach to this rifle'.[107] In these circumstances it can come as no surprise that Field Marshal Slim took a dim view of Churchill's line of reasoning and that their meetings on the subject were heated.[108]

The argument that had more purchase on the General Staff, however, was Churchill's belief that standardisation with the Americans was a manufacturing imperative. The Prime Minister was well aware of the production potential of the United States and was insistent that Britain should do nothing to jeopardise access to it in times of war.[109] On this basis what was at question was whether Britain had the capacity to deliver sufficient weapons and ammunition in preparation for and during the next conflict. Churchill quickly concluded following advice from his Secretary of State for War, Anthony Head, that Britain's need for rifles outweighed the capability to produce enough EM2s in the time allowed. Indeed, Head stated that

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[104] Some Logistics Problems Affecting the U.S. Calibre .30" t104 and UK Calibre .280" Ammunition, Ammo .280" - .280"in (7mm) Ammunition SAA 82 & D2 Series, MOD Pattern Room Archive
[105] '.280" SAA and .30" t65 type', Brigadier Barlow, 27th March 1951, WO 185/242, NA.
[106] Letter from unknown (possibly Brigadier Barlow) to Winston Churchill, July 1951, Churchill College Archives, CHUR 2/34.
[107] Ibid.
[108] R. Lewin, Slim: the Standardbearer - A Biography of Field-Marshal the Viscount Slim, (London [etc.]: Pan Books, 1978), p. 272-273; see also 'Note of the Meeting of the 20th November with the Secretary of State for War and CIGS', 21st November 1951, PREM 11/854, NA.
[109] See, 'Note by the Prime Minister', 12th November 1951.

the UK needed 1.5 million rifles, when the newly reformed Home Guard was included in the totals, whereas Britain could only produce 9000 EM2s per calendar month from 1955/1956.[110]

The need to provide the Home Guard with the same weapon as the regular force was a new line of reasoning not previously considered by the EM2 advocates and was viewed with some annoyance at the War Office. When the original decision had been taken to adopt the EM2 it had been on the basis that the total number required was 329,446 taking six years to produce.[111] Churchill, however, could use the Home Guard as a way of pointing out that Britain did not have the production capacity to go it alone and that standardisation was the only way to ensure that the UK would have enough weapons in the future. The War Office, in contrast, was rather unconvinced about the reintroduction of the Home Guard whilst the CIGS was more interested in ensuring his front line forces had the equipment that they needed.[112] In the circumstances, then, Slim did not view the production issue in quite the same way as the new Prime Minister. This belied the fact that at a deeper level Slim's concerns were not about manufacturing but rather with the job he was directly responsible for: the defence of Britain and Western Europe in future conflicts with the Soviet Union. Slim believed the EM2 to be the most appropriate weapon in the circumstances and he wanted to ensure that his troops were issued with it. Indeed he was known to have stated that the best way to show the other NATO powers the virtues of the EM2 was for the BAOR to be issued with the weapon and let it speak for itself.[113] For Slim to have to repeat the arguments that had been reproduced over the previous twelve months to a new and sceptical Prime Minister was, therefore,

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[110] Bringing back the Home Guard was some of the first legislation passed by the new Government. See A. Seldon, Churchill's Indian summer: the Conservative Government, 1951-55, (London: Hodder & Stoughton, 1981), p. 311; for revised requirement and production figures see letter from Secretary of State for War to Prime Minister, 'The .280" Rifle', 16th November 1951, PREM 11/854, NA.

[111] .280" Rifle Memorandum by the War Office and Ministry of Supply, Note by the Joint Secretary, Joint Weapons Policy Committee, 23rd July 1951, CAB 21/3465, NA.

[112] Shinwell taunted Brigadier Head by saying that, '...His attempt to enrol the Home Guard in face of advice given him has proved a complete flop', quoted from Seldon, Churchill's Indian summer: the Conservative Government, 1951-55, p. 311.

[113] Letter from Secretary of State for War to CIGS, 25th July 1951, CAB 21/3465, NA.

not something he relished. After all the arguments concerning the appropriateness of the EM2 had not changed in the month after Churchill's election.

Nevertheless, on November 20th Slim met Churchill, the Secretary of State for War and Lord Cherwell to discuss the issue.[114] At this meeting it was made clear to Slim that standardisation was a central concern of the new government. However, the CIGS was unwilling to concede the EM2 in order to realise that goal. In a subsequent heated exchange, Churchill apparently stated that, 'When I was at Omdurman I rode with a sabre in one hand and a revolver in the other' to which Slim retorted, 'Not much standardisation there Prime Minister'.[115] With the CIGS clearly more concerned with selecting a weapon he believed appropriate for the Army, Churchill eventually agreed that he would make one final try to persuade the Americans of the British case when he visited the United States in the New Year.

To be fair to the Prime Minister, the matter was raised when he met President Truman in January 1952. Indeed he is on record as stating that he saw many virtues in the .280" rifle. However, Churchill implicitly sided with the Americans at this meeting. For he also pointed out that in times of war it was important to have a large pool of rifles and that as both the United States and Britain were fighting in Korea there was little benefit from making any changes in small arms until there was a substantial period of peace.[116] The Americans could be happy with this conclusion as they had no urgent need to make the change from the M1 Garand. In contrast, the CIGS could not find much that satisfied him in this arrangement, for it meant that the British Army would be compelled to use the .303" until a new round was agreed. Increasingly it seemed that without political support at the very top of Government, the efforts of the EM2 advocates would be blocked and the War Office compelled to use American equipment. The final *coup de grace*, however, did not come from the Americans but rather the Belgian company *Fabrique Nationale*.

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[114] From the minutes it was clear that Lord Cherwell was also present. Note of the Meeting of the 20th November with the Secretary of State for War and CIGS, 21st November 1951, PREM 11/854, NA.
[115] Lewin, Slim: the Standardbearer - A Biography of Field-Marshal the Viscount Slim, pp. 272-273.
[116] The Prime Minister's Visit to Washington and Ottawa, January 1952, pp. 7-8, CAB 21/3057, NA.

Fabrique Nationale d'Armes de Guerre

With political support for the ADE weapon waning, the question was no longer about when the EM2 would be adopted but how long the Ministry of Supply could put up a rearguard action to keep the idea alive. In this context it was demoralising for the ADE and DofA (SA) that the final blow to their efforts came from a company that had been working with them both during and after the Second World War.[117] This was especially the case as FN had only been invited to work on the .280" project because of the limited amount of time available and the need to guarantee the production of a working rifle to fire the ADE's SAA.[118] The EM2 advocates never had the intention of adopting FN equipment. However, the fact of the matter was that the Belgian company was very effective at taking what chances it had in order to promote their system over all others. This penultimate section is therefore concerned with showing how FN exploited their opportunities and created an opening which ultimately led the British to adopt the 7.62mm FAL in 1957.

FN policy was shaped by the determination to have its weapons selected by one of the major powers. Accordingly, during 1946 they hawked their products around, asking for advice and direction from the ADE as well as the design departments of other nation states whilst changing features of their own weapons, all in the hope of picking up work. Initially this involved approaching the Ministry of Supply regarding their newly redesigned self-loading rifle chambered to 7.92mm calibre.[119] The Ministry was sceptical at first but eventually, the DofA (SA) convinced the Controller of Supplies (Munitions) (CS(M)) of the possibility of using the company in a limited capacity and started the process of employing them.[120] This attempt to make use of external resources was not, however, something that was well received

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[117] Letter from AP Wickens to Duncan Sandys MP, Minister of Supply, 26th January 1954, 340 (200) EM2 SL Rifles Box 1, MOD Pattern Room Archive.

[118] Letter from DofA (SA) to CS(M), 7th November 1947, WO 185/242; and letter from ACS(M) to DWD, 29th October 1947, WO 185/242, NA.

[119] See Minute Sheet notes of correspondence between DofA (SA), CS(M), DWD and FN. References include notes from 15 to 17, 20 to 27, 30, 40 to 50 located at front of file WO 185/242, NA.

[120] Ibid., references include notes from: 15 to 17, 20 to 27, 30, 40 to 50 located at front of file.

by the then DWD at the War Office. Major-General Festing wrote, 'As regards the standardisation aspect, I do not at all like the idea of having to go to the US with a rifle produced in a foreign country…'.[121] Festing was reassured, however, to know that FN would be employed only to ensure that the British had a working rifle to fire the .280" ammunition in the forthcoming trials with the Americans.[122]

Consequently, throughout 1948 and 1950, FN worked alongside the ADE in the refinement of its own self-loading rifle, re-chambering their 7.92mm model to take the .280" round and converting an additional weapon into bullpup configuration.[123] They also made a point of working on the .280" round ostensibly in an effort to improve its performance.[124] To certain members of the British small arms community it seemed that the company was clearly building 'hand made' ammunition in order to impress decision makers.[125] By August 1949 it was the view of the Ministry of Supply that the conventional design of FN weapon should be retained because it had reached a more advanced state of development, having completed its 5000 round endurance test before any of the other weapons including the EM2.[126] Accordingly when the decision was forced on the ADE to abandon two of the five designs it had available, following US intransigence over organising the trials, it was decided to drop the FN bullpup, the EM1 and a weapon made by the BSA called the P.28.[127] The Ministry of Supply consequently went to the United

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[121] Letter from DWD to ACS(M), 'Development of British Self-Loading Rifle', 4th November 1947, WO 185/242, NA.
[122] Letter from DofA (SA) to CS(M), 7th November 1947, WO 185/242, NA.
[123] Operation Niblick Stage III, Preliminary View of New Auto Rifles at Enfield Lock, 3rd March 1949, 340 (200) EM2 S/L Rifles Box 1, MOD Pattern Room Archive.
[124] Letter from DofA (SA) to CEAD, '.280" SAA', 30th January 1951, Ammo .280" – 1 .280"in (7mm) Ammunition 82 Series File, MOD Pattern Room Archive.
[125] Letter from Superintendent Royal Ordnance Factories Radway Green to 'anonymous', 10th June 1948; see also letter from A/CEAD to CEAD, 9th April 1951; and letter from A/CEAD to DofA (SA), 21st March 1951, all in Ammo .280" – 1 .280"in (7mm) Ammunition 82 Series File, MOD Pattern Room Archive.
[126] Letter from DGofA to CS(M), 8th August 1949, WO 185/242, NA.
[127] The BSA weapon is not central to the story of the EM2 and FN. The Ministry of Supply almost certainly asked the BSA to develop a weapon mainly for political reasons so that they could show they wanted to work with UK as well as foreign companies. Most of the files related to the P.28 do not seem to have survived although the P.28 appears to have been an ill-fortuned weapon, failing its proof tests. Technical information regarding the weapon can be found in Major Hobart's article: F. W. A. Hobart, 'The BSA 28P .280 Rifle', <u>Guns Review</u>, Vol: 12 No: 5 (1972), pp. 185-187.

States with two types of weapon available for testing: the FN .280" in conventional configuration and the EM2 in bullpup.

The problem that FN had, however, was that the British never really had any intention of purchasing their weapon. Major-General Festing for example asked the Ministry of Supply whether there was, '...some way we could pick FN's brains and still truthfully be able to say that the rifle was a British product...' as such a course, '...would avoid purchasing manufacturing rights and payment of royalties... if the [rifle adopted by the UK] had to be recognised as an FN design'.[128] The British view of FN was, therefore, conditional on how the company could be used in order to advance the campaign of the EM2 advocates. The problem was that when the decision was taken to adopt the EM2 in April 1951, the veneer of friendly relations quickly disintegrated as FN scrambled to emphasise the qualities of its own weapons to all those that might listen.

In these new circumstances, one of the first requests made by the company was that the British Government invite FN representatives to all trials of weapons where FN designed equipment and ammunition were being displayed. In addition the company insisted that all its designs be properly accredited before any display and at the same time pursued the ADE for damages claiming that it had been involved in the development of the .280" ammunition.[129] On the basis that the British were going to adopt the EM2, FN also re-chambered its own weapon to fire .30" ammunition and made it available to the Belgian Armed forces fighting in Korea, thereby recruiting the Belgian Government to its cause.[130] Finally the company asserted its independence from the EM2 advocates who were by that time concerned with whether the British Army would adopt the .280" calibre and continued to make its

[128] Letter from DWD to ACS(M), 'Development of British Self-Loading Rifle', 4th November 1947, WO 185/242, NA.
[129] Letter from CEAD to DGofA, '7mm Ammunition – Conditions for demonstration etc. vis-à-vis FN', 12th September 1951, Letter from Brigadier Barlow DofA (SA) to *Fabrique Nationale d'Armes de Guerre*, 15th August 1951, WO 185/244, NA.
[130] Operational Research Section, Korea, Memorandum No.1, 'Belgian FN .30" Automatic Rifle, Model M.2, WO 291/1890, NA.

weapon available for additional, US sponsored, trials held during 1952. All of this activity did not, however, prevent the company continuing to talk and work with the British. What it did was to persuade FN to protect its intellectual capital whilst pursuing a number of alternative selling opportunities.

Such an opportunity presented itself following Churchill's re-election in October 1951. With the CIGS battling and eventually failing to maintain support for the decisions made by the previous government, the DInf was forced into siding with the General Staff and breaking ranks with the EM2 advocates. The pretext for this was a re-evaluation of some trials that had been held in the spring of 1951. Ironically, these check tests, as they were known, had been ordered on the basis that the advocates needed to placate FN after the Labour Government's announcement that the British Army would adopt the EM2.[131] Ever since that decision was made public, FN had been complaining that the 1950 comparative trials had shown that their weapon was more appropriate for taking into service than any other. Therefore they believed that the choice of the EM2 was unfair and politically motivated; a claim to which there seemed to be some substance. That this was the case was entirely down to the fact that in the spring of 1951, the DofA (SA) had continuously interfered in the workings of the check tests. Indeed the examining board stated that they believed their examinations showed that FN's assertions about the 1950 trials were broadly correct and complained that

> ...the amount of interference with their powers, and direction of their opinion, was not warranted. It is difficult to take an impartial decision when one side of a question only is being continuously and forcibly emphasised...[132]

Subsequently, in December 1951, the DInf wrote to Brigadier Barlow stating that he believed the Ministry of Supply had 'doctored the patient' with regards to the EM2

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[131] Letter from DofA (SA) to BJSM, 20th April 1951, WO 185/244, NA.
[132] Rifles Automatic - .280"inch Check Tests of FN and EM2, 5th June 1951, 340 (200) EM2 SL Rifles Box 3, MOD Pattern Room Archive.

during these trials.[133] In the process the DInf revealed the presence of a fault line between the views of the ADE and DofA (SA) on the one hand and the War Office on the other. The condition that brought this about was certainly Churchill's election in October but the DofA (SA)'s forceful intervention in the workings of the 1951 check tests made it easy for the War Office to break with the views of the Ministry of Supply. FN was now presented with the chance to appeal directly to the War Office in regards to future firearms without having to go through the Ministry of Supply.

Last Act

For those who supported the idea of the EM2 what was crucial was the careful marriage of ammunition with rifle. A smaller calibre round would make it possible for the army to have a lighter weapon with increased firepower. In addition, adopting the EM2 would reduce the number of weapons in the inventory, simplify training and decrease the logistic support required for small arms. Changing the ammunition severely undermined the chances of attaining all of these possibilities and yet in 1952 with the .280" round effectively stymied by Churchill's intervention this was being contemplated. The Canadians had first suggested a compromise round following the report of the NATO Standing Group.[134] However with the Americans flatly rejecting the .280" calibre early in 1952, stating that they would not adopt any ammunition other than the .30", any new compromise ammunition intended for the NATO alliance would not have the support of its largest power.[135] Consequently, this new developmental cycle could not come to anything more than a way of helping the Ministry of Supply conclude that their technical ambitions were not to be. This final section is, therefore, concerned with showing how the War

[133] Letter from DInf to DofA (SA), 3rd December 1951, 340 (200) EM2 SL Rifles Box 2, MOD Pattern Room Archive.
[134] Letter from Secretary of State for War to Prime Minister, 4th June 1952, WO 216/374, NA. Work on this round continued throughout 1952 and into 1953, see Military Report by the Military Representatives Committee to the North Atlantic Military Committee on Standardisation of Small Arms Ammunition, 12th November 1952, RG24, Box 3502, LAC.
[135] Letter entitled 'Compromise Small Arms Round' from Brigadier A.E. Wrinch to Major-General S.F. Clark, 8th February 1952, RG24 Box 3502, LAC. See also Dugelby, EM-2 Concept and Design: a Rifle Ahead of its Time, p. 166.

Office finally managed to realise its aim of procuring an automatic rifle without having to wait until the Americans adopted something to replace the M1 Garand.

The difference between the efforts of the Ministry of Supply before the US/UK comparative trials of 1950 and those after Churchill's election was the fact that the DofA (SA) and ADE were now forced into working collaboratively with the Belgian and Canadian governments.[136] A Belgian, British and Canadian (BBC) committee was established to look into the technical problems and partition out work between the three powers.[137] For the Belgians this involved employing FN to act on their behalf, forcing the British to accept a degree of equality and openness with the company that previously did not exist. It also meant that both the Canadians and Belgians now had access to staff at the War Office in a way that had not previously been available.

The underlying problem, however, remained the fact that the Americans would not back away from their commitment to the .30" calibre. And yet the chairman of the BBC committee, Brigadier Barlow, insisted on continuing with tests and trials of both ammunition and weapons despite the growing evidence to indicate that there was no future benefit from doing so.[138] The ADE was becoming increasingly frustrated with having to work on ammunition it believed provided no tangible benefits when compared to the t65 round.[139] In the end the CEAD believed that the

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[136] Letter from Secretary of State for War to Prime Minister, 4th June 1952, WO 216/374, NA; New SAA and the New Light Rifle, Note by the CS(M) for the Secretary of State at the Ministry of Supply, 21st April 1953, WO 185/320, NA.

[137] The decision to set up this committee was first taken by General Guy Simonds the Canadian Chief of the General Staff and General Sir John Whiteley the DCIGS at a War Office meeting in May 1952. See, Directorate of Armament Development Canadian Participation in Tripartite Small Arms Standardisation Programme, Development Report No. 6, 12th May 1952, RG 24 Box 3502, LAC. The official title of the committee was the Small Arms Development Committee and it first met in the summer of 1952, see Minutes of Informal Meeting of Technical Representatives of the Small Arms Development Committee, 25th June 1952, 120 Meetings – Conferences (Future Design of Weapons) - Box 2, MOD Pattern Room Archive.

[138] Minutes of Informal Meeting of Technical Representatives of the Small Arms Development Committee, 25th June 1952, 120 Meetings – Conferences (Future Design of Weapons) - Box 2, MOD Pattern Room Archive.

[139] Letter from CEAD to DofA (SA), 3rd June 1952, 120 Meetings – Conferences (Future Design of Weapons) - Box 2, MOD Pattern Room Archive.

War Office ought to adopt the t65 round and tap into American production capacity rather than continue work on a round that satisfied no-one. It seemed that the alliance between the DofA (SA) and the ADE had now come to an end, for the engineers recognised that the game was up.

However, Brigadier Barlow was not quite ready to concede defeat. Clearly the ambition of DofA (SA) was still that the British Army ought to adopt a British design of rifle even if the Churchill government was not prepared to take the .280" ammunition. During the course of 1952, a number of EM2s were re-chambered to fire both the compromise round and the t65 with a view to undertaking trials in 1953.[140] The DofA (SA) was confident that the EM2 would perform strongly in any future test but in his eagerness Barlow also demonstrated that claims about a British design philosophy which emphasised the importance of building the rifle around the ammunition were as much about marketing as they were about optimum design. In reality the ADE had opted for a bullpup design in 1946 before the ammunition issue had been resolved. Now with the DofA (SA) busily re-chambering the EM2 to take larger ammunition what was clear was that the most important thing for him was to win: for the designs he was intimately involved in to be selected over those of any other nation or company.

Thus it was with a deep sense of irony that at a meeting with the DInf at the War Office, FN insisted that the real issue at stake was deciding on the future calibre of ammunition before selecting a rifle.[141] They argued that if the Americans insisted on the t65 then what would be the purpose of the other powers going it alone? As it was, when faced with representatives of the Canadian government and FN, the DInf was not quite ready to let go of the idea that the British Army should be equipped with a British design of infantry weapon and so for the last time he sided with

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[140] Minutes of the meeting of the Technical Representatives of the Small Arms Development Committee, 24th September 1952, 120 Meetings – Conferences (Future Design of Weapons) - Box 2, MOD Pattern Room Archive.

[141] Recommendation of the BBC committee from 24th September 1952, see Minutes of the meeting of the Technical Representatives of the Small Arms Development Committee, 24th September 1952, 120 Meetings – Conferences (Future Design of Weapons) - Box 2, MOD Pattern Room Archive.

Brigadier Barlow and allowed the trials to continue.[142] It was at this point that higher authority at the War Office finally intervened to bring to a close the question of whether or not to adopt the EM2.

In April 1953, the War Office decided that they had had enough of waiting for the technical establishments to catch up with their views on the need to work with the Americans. Accordingly the new DCIGS, Lieutenant-General Dudley Ward, wrote to the former DCIGS, Lieutenant-General Crawford, now the CS(M) at the Ministry of Supply, asking him to consider an Army Council paper that set out the reasons why Britain should adopt the FN FAL[143] This document said that the selection of a new automatic rifle was an imperative and that a choice about which weapon the British Army should have could be made without having to further examine the ammunition question. Moreover, the DCIGS continued by stating that whilst both the EM2 and FN were excellent weapons there were two advantages the FN possessed which the British weapon did not: that it cost less and that it would take less time to get the weapon into the hands of the British Army.[144] The DGofA and the DofA (SA) were consequently forced by CS(M) to look at the issue one last time this time taking into account the views of the DCIGS.

Following a meeting between the DGofA, the DInf and the DWD it was stated that they were, '...solidly of the opinion that there is a real urgency to equip the Army with a new rifle as early as possible...' and that the, '...development of the EM2 should continue as an insurance... [as]...it would have to show a greater superiority in performance and an improved cost ratio for it to supplant the FN at some future date'.[145] Moreover, as Canada was prepared to adopt the FN but not the EM2 this weighed heavily in favour of Britain doing the same. Needless to say the DofA (SA)

[142] Minute of Meeting held in War Office between Canada, FN, Ministry of Supply and DInf, 3rd October 1952, 120 Meetings – Conferences (Future Design of Weapons) - Box 2, MOD Pattern Room Archive.
[143] Letter from Lt Gen Ward (DCIGS) to Gen Crawford (CS(M)), 17th April 1953, WO 185/320, NA.
[144] Adoption of the New Rifle, paper by the DCIGS for the Army Council, 17th April 1953, WO 185/320, NA.
[145] Letter from DGofA to CS(M), 23rd April 1953, WO 185/320, NA.

protested that the reason the EM2 was more expensive was because it included an optical sight whilst the FN did not, therefore, the War Office was not comparing like with like.[146] Unsurprisingly, given the mood among the General Staff this last throw of the dice was to come to nothing. The War Office had made up its mind. By late 1953, after some continuing discussion the French, American and British governments finally accepted that the US .30" SAA would be a satisfactory round.[147] By 1957, following further negotiations with the other treaty organisation countries, it was clear that it would also prove acceptable to the wider Alliance powers and was subsequently renamed the 7.62mmx51mm NATO Standard.[148] The next weapon to be adopted by the British Army was to be a single shot, self-loading rifle of Belgian design using an American standard of cartridge, all of which bore no relation to the battlefield conditions that inspired its selection.[149]

Conclusion

If weapons selection followed a technologically determined trajectory from less to more efficient weapons then the selection of the EM2 ought to have been inevitable. Not only was automatic rifle technology well understood but other nations had demonstrated that it could be made to work in combat. With the ability to fire in single shot and full automatic mode, the adoption of the EM2 would have led to a significant increase in the destructiveness of the infantry. On top of this the weapon was based on a full appreciation of the battlefield environment as understood by those members of the Committee on Infantry Weapon Development. In many respects then, for the British the EM2 represented the 'ideal' technical solution to the problem of infantry combat.

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[146] Letter from DofA (SA) to DGofA, regarding Paper by the DCIGS, 22nd April 1953, WO 185/320, NA.
[147] Ezell, 'Cracks in the Post-War Anglo-American Alliance: The Great Rifle Controversy, 1947-1957', p. 141.
[148] Huon, Military Rifle and Machine Gun Cartridges, p. 100; interview with Mr Hank Visser, Wassennaar, 23rd September 2004.
[149] The decision was ratified by a full meeting of the Cabinet on 1st December 1953, PREM 11/854, NA.

However, neither the technical logic nor the fact that the EM2's development was founded on well thought through arguments was enough to bring about its successful selection. For example, the EM2 advocates had worked hard to demonstrate the viability of their rifle but this did not stop their efforts from running into trouble with those actors who were committed to adopting a standardised weapon that also met US requirements. In the first instance, negotiations with the General Staff led the advocates to realise that if their ambitions were to have a chance of becoming a reality then they would need to agree that their .280" SAA would also match the .30'06 round at 2000 yards. Whilst this was enough to placate the British sceptics it was not sufficiently persuasive to those Americans already committed to .30" calibre ammunition and their own design of firearm. But this was not just a debate based on resolving technical details. On the contrary, underlying the US position was a view of infantry combat that was significantly at odds with that of the EM2 advocates; and in the final analysis it was the tension between these two views of battle that started the process through which the British position unravelled.

What is clear, then, is that the Americans were unwilling to reinterpret the battlefield problem in ways that matched their British counterparts. Instead they chose to find a way to undermine the case being put forward by the EM2 advocates. With access to their own sources of information and experimental data, this took a number of forms that ranged from altering the terms of the trials to making last minute changes to the specification for rifle grenades. The most corrosive form of counter argument being proposed by the Americans was, however, the claim that the .280" round was incapable of matching the US requirement that a bullet strike a victim with at least 87.57ft/lbs at 2000 yards. Technically speaking the American position was accurate given their appreciation for the science of wound ballistics. Not only could they clearly demonstrate that the British ammunition was by their definition underpowered but they also had a scientific basis for rejecting the work undertaken by the EM2 advocates.

That said, if the problem of wound ballistics was defined differently, taking into account the work undertaken by Zuckerman et al., then the US ordnance officials' perspective on the .280" round appeared to make little sense. In this respect where the Americans were successful was in relation to how they redefined the problem in ways that suited their views on infantry combat and then skewed the terms of the debate so that other sceptical actors might also see the matter in the same way. Forcing the British to concede that their ammunition had insufficient velocity fed a debate that questioned whether a smaller calibre round could ever be sufficiently lethal.

In the 1950s scientists were still a long way off from reaching agreement on what constituted a wounding criterion. Utilising the science in defence of a technical choice could not therefore provide a conclusive reason for choosing one system over another. Accordingly, the selection of US ammunition in 1953 had to be taken on the basis of socially contingent rather than technically ideal factors. This is clearly brought out in relation to the involvement of the Canadians, the French, the Churchill Government and the Belgian company *Fabrique Nationale*. Ultimately, all four actors failed to see a solution to their respective problems in the British .280" round. Moreover, working on the basis of terms defined by the Americans it became increasingly difficult for the EM2 advocates to construct arguments that would help the sceptics look on the EM2 differently. Despite its sophisticated design, the British found themselves locked into a descriptive narrative from which they found increasingly difficult to escape. As a result, the EM2 advocates were eventually forced into abandoning their rifle in favour of the single shot FAL. Not only does this choice show that the EM2 was not sufficiently capable of interpretive flexibility but it also demonstrates that the technological determinist argument is fatally flawed.

Chapter Seven - Section Small Arms Post 1980 (SA80)

In 1985 the British Army adopted 5.56mm NATO standard ammunition and put the SA80, a rifle that had been designed by engineers at the Royal Small Arms Factory, into service to fire it.[1] Thirty-five years after a Labour Government had initially held out the prospect, troops were finally to be issued with a weapon that could function as both a self-loading rifle and a sub-machine gun (SMG). The ambitions of Britain's small arms community were not, however, limited simply to delivering on the aspirations of the EM2 advocates. Rather, a new set of socio-technical imperatives dominated the development programme. With Britain remaining committed to defending Europe, preparing for conflict in West Germany took on particular importance for the General Staff. But whilst the Army got ready for war on the central front the main source of military activity continued to be post-colonial small wars and policing actions.[2] These divergent missions created tensions over where Britain's main effort ought to be directed.[3] Should resources be committed to defining and optimising technical solutions that addressed problems associated with fighting in Germany or should other more global considerations feature in equipment choices?

Of course Britain's armed forces had faced such dilemmas previously but, as this final case study contends, the reason why the Section Small Arms Post 1980 was successfully adopted was because it could overcome these potentially conflicting ways of understanding the main threat.[4] That this was possible was entirely down to

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[1] From an examination of the Extracts for Approval (the index that replaced the List of Changes from about 1965) it is not possible to establish the exact date at which the SA80 entered into service. The L85A1 designation for the weapon suggests it was formally adopted in 1985. Certainly large scale orders for the weapon were placed with the RSAF in July 1985. See 'Handover Programme SO2 INF WPNS(a)', December 1990, 120 Meetings – Conferences (Future Design of Weapons) Box 2, MOD Pattern Room Archive.

[2] A fuller description of Britain's post-war military engagements can be found in J. Thompson (ed.), The Imperial War Museum Book of Modern Warfare - British and Commonwealth Forces at War 1945 - 2000, (London: Pan Books, 2003).

[3] C. McInnes, Hot War Cold War - The British Army's Way in Warfare, 1945-1995, (London: Brassey's, 1996), p. 180.

[4] This is not to suggest that the SA80 L85A1 or LMG L86A1 did not suffer a number of engineering faults when it was first given to troops, just that the concept of the weapon was acceptable to the

the technology's interpretive flexibility. Certainly, the new weapon satisfied an agenda that had first been laid out during the Second World War but it had to do so much more. Not only did it enable tactical flexibility but it also represented the ambitions of a new generation of infantryman. In particular the weapon had to deal with three distinct concerns. Firstly, it had to be appropriate for low-intensity operations which were subject to control by civilian authorities and where scrutiny by judicial and media organisations were the norm. Secondly, in high-intensity engagements it had been decided that some infantry would function in support of armoured formations in a mechanised role. Future small arms had to be suitable for these specific conditions. And finally, the use of armed force outside the projected main European theatre of operations meant that firearms would have to be light, allow the soldier the option to fight using what he carried on his person and require a limited amount of logistical support. Each of these requirements could have produced a variety of solutions. That they did not suggests that the Section Small Arms Post 1980 was agreeable to a number of different constituencies who could find what they needed in the new system.

That said, it is not easy to precisely pick apart how the various relevant groups defined their weapon choices. This is because the vast majority of archive documents concerning the Section Small Arms Post 1980 are still unavailable for inspection. It is consequently a lot harder to identify and categorically define all the actors interested in the equipment's development, establish whether alternative rifles were examined by the British Army before the SA80 was selected or explore the organisational politics associated with a change in weaponry. The competitive NATO ammunition trials undertaken during 1978-79 demonstrate this point most clearly. The story may indeed be simple but without access to the sources it is only possible to observe that the British Army agreed to make the 5.56mm round a NATO standard. Whether the trials were as political as those associated with EM2 remains to be seen. What follows is therefore a matter of some educated

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various constituencies within the Army. For the Parliamentary investigation into the weapon's failings see, 'The SA80 Rifle and Light Support Weapon, Report together with the Proceedings of the Committee relating to the Report, Minutes of Evidence and Memoranda', (London: HMSO, 1993).

interpretation; something that has only been made possible through the examination of those materials that are in the public domain and by interviewing certain individuals involved in the system's creation and selection. From this an outline scenario can be produced that explores why the weapon took the form that it did.

Keeping in mind the difficulties experienced in accessing primary sources, this case study will have a noticeably different shape from previous chapters both in terms of depth of primary source materials and in structure. Specifically, in contrast to exploring the perspectives of the various relevant social groups, this chapter starts by outlining the key environments in which the Section Small Arms Post 1980 was to be deployed.[5] Based on an understanding of both previous conflicts and situations the Army was predicting to fight in, it becomes easier to work backwards and explain why certain design features were favoured over others. None of this is intended to suggest that weapon selection was either inevitable or anything other than a human activity. Indeed, what will become evident is that there were many options available to decision makers, including a variety of commercial off-the-shelf firearms, and many choices had to be made before a replacement to the SLR could be properly defined. Issues ranging from NATO standardisation, for example, to the evolution of new forms of doctrine had a bearing on the design of the Section Small Arms Post 1980; all of which suggests that there was an underlying debate between a number of protagonists within the Army and the wider community of interests.

Accordingly, this chapter is structured to show how such a debate might have unfolded. Through an examination of the issues associated with firearms use in three distinct environments the underlying assumptions and perspectives facing those involved in weapon selection are laid bare. By focusing attention on operations in Borneo, Northern Ireland and in West Germany, this analysis shows how differing socio-technical agendas can be knitted together. For example how could the tactical concerns of the light infantryman marry with the requirements of

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[5] This approach was also outlined by Lieutenant-Colonel Weeks of the Parachute Regiment and later project manager during the early years of the SA80 development programme. See J. S. Weeks, 'Keep it Small', British Army Review, Vol: 27, (1967), p. 13.

mechanised manoeuvre warfare? How were the demands of close quarter fighting in urban environments related to the potential need to strike targets out at range? And how could one weapon system satisfactorily replace four firearms? Without getting too fixated on identifying all the relevant actors the goal of this case study is to explore the possible interpretive flexibility of the Section Small Arms Post 1980 by relating it to the circumstances in which it was expected to be used.

Before proceeding it is worth explaining some of the technical features of the Section Small Arms Post 1980, both to prevent any confusion and in order to show how it differed from the weapons discussed in previous chapters. The first thing to note is that the Section Small Arms Post 1980 was in fact two types of firearm. The first was known as an Individual Weapon (IW) and described within the Army as the SA80 L85A1. The second was called the Light Support Weapon (LSW) and given the designation LMG L86A1. 80% of the parts used in the IW and LSW were interchangeable between the two weapons. Each firearm utilised the same 30 round magazine, was designed in a bullpup configuration and could fire both single shots and in continuous fire. Both weapons were also provided with a Sight Unit Small Arms Trilux (SUSAT) optical sight for front line troops and a conventional aperture, unmagnified iron sight for emergencies and rear echelon troops. The LSW had a bipod support and was intended as an infantry section weapon to replace the General Purpose Machine Gun (GPMG) in the light role and the Bren LMG.[6] The IW, by contrast, became the standard soldier's personal weapon replacing both the 7.62mm L1A1 Self-Loading Rifle (SLR) and the 9mm Stirling L2A1 SMG.[7] As mentioned previously, the SLR was the British name for the anglicised version of *Fabrique Nationale's* conventionally configured *Fusil Automatique Léger* (FAL) which had been adopted in 1957 following the decision to abandon the EM2.[8] Throughout the

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[6] The GPMG can be used in a sustained fire role where it is mounted on a tripod or in a light LMG role where it has a lighter barrel and a bipod. In the light role it was used as a section weapon in place of the Bren LMG.

[7] Operational Requirements Committee Section Small Arms Post 1980 (GSR 3518) – (Paper by the Army Department), 14th August 1974, p. 1, WO 188/2485, National Archive (NA).

[8] See List of Changes, LC. C8288 or Extracts for Approval EA W/321, MOD Pattern Room Archive. When the British Army agreed to adopt the FAL it was decided that the metric measurements used by

1970s development cycle both the IW and LSW had been optimised to fire a British designed 4.85mm round. By the time the weapons were adopted, however, both weapons used the same NATO standard 5.56mm small arms ammunition (SAA). Importantly, both weapons ejected cartridges out of the right hand side of the receiver making it impossible for either the SA80 or LSW to be fired from anything other than the right shoulder.

Borneo

The British Army has a long history of operations outside Europe, either in defence of Empire or whilst in the process of withdrawing from it. In the period between 1945 and 1989, for example, Britain's armed forces were involved in small wars or policing actions in Palestine, Malaya, Egypt, Kenya, Oman, Borneo, the Yemen, Dhofar and the Falklands Islands.[9] Despite the ongoing preparations for a hot war in Europe the British Army's combat experience was mainly being garnered from activities undertaken outside the North Atlantic Treaty area. It was only during the Korean War (1950-1953) that the Army had to fight a high-intensity battle in a non-European location. Decisions over whether to replace the SLR, and if so with what, were therefore being taken against a backdrop of a particular type of engagement: one that favoured the skills of the light infantryman. Regularly used without armour, these formations, although capable of a wide variety of missions, were extremely useful in urban, mountainous or jungle environments against lightly armed insurgents.[10] Equipped with small arms, mortars and mines, the light infantry advanced on foot and fought with only what they could carry. Consequently, equipment weight was a genuine issue. Bearing in mind that conflict in Borneo resulted in the largest deployment of British service personnel since the Second World War, stimulated significant criticism of the SLR and GPMG, and reinvigorated interest in small arms, this section focuses on the problems of weight

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FN would be converted to imperial and new drawings issued from which the RSAF would work. Unfortunately this resulted in significant problems with the early RSAF versions of the SLR.

[9] Palestine 1945-1948, Malaya 1948-1960, Egypt 1951-1956, Kenya 1952-1956, Oman 1958-1959, Borneo 1963-1966, the Yemen 1964-1967, Dhofar 1965-1975 and the Falklands 1982.

[10] S. McMicheal, <u>A Historical Perspective on Light Infantry</u>, (Fort Leavenworth, KS: Combat Studies Institute, 1987), pp. 231-234.

versus mobility in relation to this operation.[11] What will become clear is that not only did the jungle shape the Army's decision to adopt the M16 for Far East Land Forces but Borneo also set the context for small arms design choices being made during the 1970s.

British military involvement in Borneo came about following Indonesia's decision to incite revolt in Sarawak and Sabah. In an attempt to create a bulwark against the spread of communism in South East Asia these two Crown Colonies had been encouraged by Britain to form a Federation of Malaysia with Malaya and Singapore.[12] President Sukarno, the Indonesian leader, took exception to this possibility and sided with indigenous Chinese communist insurgents in an effort to prevent the creation of this new political entity.[13] A communist rebellion in Brunei resulted in the deployment of British troops in 1962. By 1963 Britain's commitments increased as both Sabah and Sarawak slid into civil war. Initially the Army made extensive use of the Gurkhas and SAS. This soon expanded to include a number of battalions mainly, but not exclusively, drawn from light infantry regiments.[14] The war in Borneo lasted until August 1966 when the Indonesians finally called off the confrontation.[15]

The dominant terrain over which the British Army fought was mountainous and covered in jungle. With forward bases along the remote border regions with

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[11] See W. Walker, 'Brunei and Borneo, 1962 - 1966: An Efficient Use of Military Force', in The Imperial War Museum Book of Modern Warfare - British and Commonwealth Forces at War 1945 - 2000, J. Thompson (ed.), (London: Pan Books, 2003), p. 218.
[12] C. Tuck, 'Borneo 1963-66: Counter-insurgency Operations and War Termination', Small Wars and Insurgencies, Vol: 15, No: 3 (2004), p. 90.
[13] The reasons for Sukarno's decision were complex but related to both domestic and anti-colonial concerns, see Ibid., p. 91.
[14] For example, other Regiments included the Argyll and Southern Highlanders, Durham Light Infantry, King's Own Scottish Borderers, King's Own Yorkshire Light Infantry, the Parachute Regiment, Royal Green Jackets, Royal Marine Commandos, Royal Ulster Rifles and the South Wales Border Regiment. A number of other units were also involved including members of the Queen's Royal Irish Hussars, the Royal Tank Regiment and the Royal Artillery. It should also be noted that a sizeable contingent of Australian and New Zealand forces were present as well. For a list of all the assets available to General Walter Walker, Director of Borneo Operations see, Walker, 'Brunei and Borneo, 1962 - 1966: An Efficient Use of Military Force', pp. 213-214.
[15] D. Healey, The Time of My Life, (London: Michael Joseph, 1989), p. 289.

Indonesia, resupply by air put a premium on helicopter support.[16] This necessarily restricted the equipment load that could be carried to the frontlines. But logistics were not just a problem for battalion commanders seeking to ensure they had sufficient material to maintain offensive operations. Individual soldiers as well as section, platoon and company formations also had to wrestle with the problem of mobility versus weight. There was nothing particularly new about this problem. Carrying a GPMG in the light role could provide additional fire when engaged with the enemy but it would come at the expense of speed, not just for the man carrying the 22lb weapon but also for the entire section that would have to bear its ammunition.[17] What was peculiar to the South East Asian tropics, however, was that both the environment and tactical doctrine demanded more from infantryman.[18] Experience in Burma and Malaya had shown that troops should not restrict themselves to travel by road but must be prepared to fight in the jungles and make use of active patrols and ambushes whilst avoiding well-used tracks.[19] In these conditions, excessive equipment weight could make hacking through the forest even more difficult than it might otherwise be, factors that had considerable bearing on the tempo of operations.[20]

Environment, tactics and weight were not the only factors shaping infantry combat. The range at which engagements took place was also of significant importance to the soldier. In Borneo, troops were primarily armed with the SLR. As will be recalled from the previous case study, the .30" calibre (eventually known as the 7.62mm NATO) round fired by the SLR had been made suitable for hitting targets out to 2000 yards. But experience in Sabah and Sarawak showed that 85% of engagements

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[16] Ibid., p. 230.

[17] See 'Record of Meeting held in West Brigade Kuching on Monday, 15th February, 1965 to discuss the Armalite Rifle', DEFE 24/644, NA.

[18] McMicheal, A Historical Perspective on Light Infantry, pp. 115-116.

[19] D. Marston, 'Lost and found in the jungle: the Indian and British Army jungle warfare doctrines for Burma, 1943-1945, and the Malayan Emergency, 1948-1960', in Big Wars and Small Wars - The British army and the lessons of war in the twentieth century, H. Strachan (ed.), (London: Routledge, 2006), pp. 92-93 and p. 101-103, McMicheal, A Historical Perspective on Light Infantry, pp. 107-114.

[20] In the jungles of Borneo it could take an hour to traverse just 200 metres. See M. Kelly, The Last Conflict: the Durham Light Infantry, Borneo 1966, (Bristol: Broadcast Books, 2004), p. 78.

occurring on the border regions took place at ranges no further than 200 yards and in forests at ranges under 100 yards 80% of the time.[21] The .30" was clearly a powerful round capable of engaging targets at distance but given the difficulties faced by troops fighting in the jungle it was too powerful. At the same time, the SLR, whilst capable of controlling the recoil energies produced by its ammunition, was long, unwieldy and too heavy for the rain forests of South East Asia.[22] Without a selective fire capability and weighing in at 5.06kg (11.1lbs) when loaded with a twenty round magazine it was not easy to engage a fleeting target, especially when the close jungle environment prevented the soldier from bringing his long SLR to his shoulder.[23]

With troops finding the conditions tough, the tactics demanding and the equipment cumbersome and inappropriate for the jungle it did not take long before Far East Land Forces Command (FARELF) sought an alternative firearms solution that would solve its mobility versus weight problem.[24] What is surprising, however, is that the answer to the British Army's battlefield dilemmas should come from small

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[21] See, 'Ranges of Small Arms Engagement in Borneo', December 1965, WO 291/2514, NA. Broadly speaking this corresponded with evidence from Malaya and Burma. For example in Malaya 70% of engagements when on Patrol occurred at ranges of less than 100 yards, 80% of ambushes during the day occurred at ranges below 60 yards and 86% below 50 yards during night ambushes. See 'Performance of small arms weapons including .280 (7mm) rifle, used in machine carbine role in Malaya', March 1953, WO 291/1668, NA.

[22] Walker, 'Brunei and Borneo, 1962 - 1966: An Efficient Use of Military Force', p. 218, McMicheal, A Historical Perspective on Light Infantry, pp. 141-142.

[23] For the weight and length of the SLR see, 'The SA80 Rifle and Light Support Weapon', p. 41. With regards to weight similar comments were made about the weapon in the Falklands. However, the development of the SA80 was already well in hand by the time of the operations in the South Atlantic and, of and by itself, the war did little to change small arms requirements. Where the fighting did have an impact was on reinforcing battlefield interpretations that had been considered previously, see S. Ball, 'The Unchanging Lessons of Battle: the British Army and the Falklands War, 1982', in Big Wars and Small Wars - The British army and the lessons of war in the twentieth century, H. Strachan (ed.), (London: Routledge, 2006), pp. 149-150. For example, the lack of a selective fire rifle was viewed by some as a particular problem. Indeed, it is has been noted that members of the Parachute Regiment were happy to discard their single shot SLR in favour of the selective fire FN FAL used by the Argentines. It is also frequently claimed that by strategically placing a matchstick in the trigger mechanism of the SLR it is possible to make it fire in continuous mode. See personal correspondence with Professor Richard Holmes, 19th December 2006. Professor Holmes conducted wide-scale interviews with 2 and 3 Para after the defeat of the Argentines as part of research for his book R. Holmes, Firing Line, (London: Cape, 1985).

[24] See note from Commander FARELF to DCGS, 22nd February 1965, DEFE 24/644, NA; and G(Operational Requirements and Analysis) Memorandum No. 2/65, 'A summary of the evidence from the FARELF trial of the AR15 Rifle ("Armalite")', March 1965, WO 291/2346, NA, p. 1.

arms developments occurring in the United States. In the period immediately after Churchill's intervention into the EM2 debate the Americans had continued work on developing a .30" (7.62mm NATO) weapon to replace the M1 Garand. Designated the M14 and eventually adopted in 1957 the new rifle satisfied the Stilwell Board's demand for a .30" calibre round. Where it failed was in relation to its weight and the provision of greater volumes of fire. For at 11lbs 4oz (5.10kg) the weapon was unable to shoot accurately when firing continuously and as a result was finally issued to troops as a self-loading rifle.[25]

Even without a selective fire capability, however, the M14 was proving itself to be as unsuitable for American infantry in the jungles of Vietnam as the SLR was for British troops in Borneo.[26] With communist forces increasingly armed with the AK47 assault rifle, General Westmoreland, the US commander in Vietnam, was eager to find an alternative solution to Stilwell's demand for 'greater firepower, lighter weight'. The remedy was provided by Eugene Stoner of the Armalite Corporation, who had been asked by the US Infantry Board at Fort Benning to design an unofficial rifle known as the AR15.[27] Not only was this new weapon considerably lighter than the M14 but it was more able to cope with firing continuously. Using a high velocity, small calibre 5.56mm bullet and renamed the M16, it weighed just over 7lbs (3.2kg) and was particularly effective at short ranges, i.e. below 300 yards.[28] Initially used by US Special Forces and Airborne Divisions in Vietnam during the early 1960s, by 1968, when the terms of the original NATO

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[25] See Hogg, Jane's Guns Recognition Guide, p. 344.

[26] McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, p. 123.

[27] Ibid., p. 59. The AR15 went UK specific modifications but for the sake of simplicity it will now be described as the M16.

[28] For the AR15's weight and more importantly the distribution of weight across the platoon see, 'Distribution of the Weights of the Various Small Arms Combinations' found in G(Operational Requirements and Analysis) Memorandum No. 2/65, 'A summary of the evidence from the FARELF trial of the AR15 Rifle ("Armalite")', March 1965, WO 291/2346, NA; for details about the AR15s accuracy and range capabilities see G(Operational Requirements and Analysis) Memorandum No. 2/65, 'A summary of the evidence from the FARELF trial of the AR15 Rifle ("Armalite")', March 1965, p. 3, WO 291/2346, NA.

standardisation agreement on SAA had lapsed, the M16 was adopted by the US Army as a whole.[29]

Given the geographical proximity between FARELF and US forces in Vietnam it seems likely that the British heard about the M16's effectiveness well before the weapon underwent troop trials in Borneo during April 1965.[30] This supposition is based on two observations. The first is that the Armalite Corporation was adept at marketing its weapon to various branches of the US armed forces and there is no reason to think that they might not have tried to do the same to commanders in FARELF.[31] The second is that in the short period following its introduction in 1962, the rifle had earned a reputation for being extremely destructive among American and South Vietnamese forces.[32] In particular, stories started to circulate that the 5.56mm bullet tumbled inside the body of the victim causing wounding of an explosive nature.

Trialling the rifle in Borneo, British troops were coming to similar conclusions which, whilst difficult to validate, served only to create an aura of destructiveness about the M16.[33] That is not to say that these accounts were not useful to the Armalite Corporation. Indeed, Eugene Stoner sought to make a virtue out of the smaller calibre issue when he wrote,

> ...bullets are stabilized to fly through air, and not through water or a body, which is approximately the same density as water.... When they hit

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[29] For an indication of the M16's successful use by Special Forces and other units in Vietnam and its adoption Army wide see, McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, pp. 123, 127-128.
[30] Brief prepared for DCGS on purchase of lightweight rifles for FARELF, 3rd March 1965, DEFE 24/644, NA.
[31] McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, pp. 78-80. There is also some suggestion that the M16 went through trials in FARELF before they had been examined in the UK. This may have been because Armalite were in direct contact with British commanders in the Far East, see letter from MGO to Secretary of State, 9th March 1964.
[32] Ibid., p. 84.
[33] One soldier stated in a post action review that, 'The top of [the victim's] head flew off...'. See Armalite Post Action Report on 23rd February 1965, DEFE 24/644, NA. See also letter from DCSA to Deputy Secretary of State, 19th February 1965, DEFE 24/644.

something, they immediately go unstable... If you are talking about a .30 caliber bullet, that might remain stable through a human mass... while a little bullet, being it [sic] has a low mass, it senses an instability situation faster and reacts much faster. This is what makes a little bullet pay off so much in wound ballistics.[34]

However, in a British context, accounts from Borneo and Stoner's own narrative did not necessarily lead those with an interest in small arms to the conclusion that the SLR should be abandoned. On the contrary, the stories emerging from South East Asia furnished groups who had concerns about the M16 with a number of grounds for opposing its selection. At one end of this debate were those who viewed the smaller calibre round as insufficiently lethal for environments other than the jungle. At the other were those concerned that if the weapon was as destructive as reports from South East Asia were suggesting then, like the dum-dum controversy of the Second Boer War, the Stoner rifle was probably in breach of the Geneva Conventions.[35]

Both of these lines of reasoning were dismissed by Sir Solly Zuckerman, who by 1965 was the Chief Scientific Advisor (CSA) to the Ministry of Defence. As far as the CSA was concerned small arms engagements taking place at ranges up to 100 yards were not peculiar to the jungle but reflected the statistical evidence derived from Second World War infantry combat including that from less extreme geographical environments.[36] There was, therefore, no statistically derived reason for denying the use of the M16 to the Army as a whole. At the same time, according to the CSA, the 5.56mm bullet neither had any special properties that made it perform differently from other ammunition nor would it contravene international

[34] Quoted from J. Fallows, 'The American Army and the M16', in The Social Shaping of Technology, D. Mackenzie and J. Wajcman (eds.), (Maidenhead: Open University Press, 1999), p. 383.
[35] This was the concern of Treasury lawyers who wanted the issue of ammunition lethality resolved before further purchases of the M16 were undertaken, see letter from Assistant Treasury Solicitor to Assistant Secretary Armament Design, 2nd March 1964, DEFE 24/644, NA.
[36] See 'Record of Meeting held in West Brigade Kuching on Monday, 15th February, 1965 to discuss the Armalite Rifle', DEFE 24/644, NA.

laws on munitions.[37] If anything, the M16's high velocity, small calibre round served only to confirm the findings Zuckerman had deduced both during and after the Second World War.[38] As he pointed out when he visited FARELF in Borneo, '...there could be no doubt about the ability to stop and to kill with a weapon whose muzzle velocity was higher than the SLR, even though the weight of its bullets was very much less'.[39] The CSA had come to the conclusion that the M16 made the wounding phenomena he had studied twenty years previously into an engineering reality. Developments in Vietnam and Fort Benning thus appeared to provide the British Army with a firearms solution to the challenges it faced in Borneo.

The difference compared to the arguments of the 1950s, was that this time the direction of the debate was more open to the possibility of a smaller calibre round. Not only were Americans advancing a case for 5.56mm ammunition, Zuckerman was now in a position of great influence at the Ministry of Defence. At the same time Britain had a real need for a lighter weapon with greater volumes of fire. Thus with the Chief of Defence Staff convinced of the operational need and the CSA happy with the scientific reasoning, FARELF was given permission by the Deputy Secretary of State to proceed with the procurement of 5000 M16s.[40] But whilst this overcame an urgent battlefield need there were still lingering doubts among a number of UK based constituencies with an interest in small arms. For them the question was whether the decision to acquire the M16 might cause problems at a later stage.

The most obvious constituent member of these groups was the Master General of Ordnance (MGO) who, following the closure of the Ministry of Supply, was re-established within the Ministry of Defence and made responsible for equipment

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[37] Letter from CSA to CDS, 18th February 1965.

[38] Zuckerman had been appointed a consultant to the Chemical Defence Experimental Establishment investigating wound ballistics in 1955, see letter from Chief Supt. CDEE, Porton Down to AD, CDRD, , 7th December 1955, WO 188/2206, NA.

[39] See 'Record of Meeting held in West Brigade Kuching on Monday, 15th February, 1965 to discuss the Armalite Rifle', DEFE 24/644, NA.

[40] Message from DCSA to CSA, circa 19th February 1965, DEFE 24/644, NA.

procurement within the Army. From the MGO's perspective the main problem generated by the decision to equip FARELF with M16s was that it might re-open the calibre debates that had been finally sorted out with the adoption of the 7.62mm NATO standard.[41] In 1961 the West Germans had already indicated a desire to abandon the 7.62mm NATO round in favour of their own design of ammunition.[42] There was therefore, some justifiable concern that a change in calibre might start the process of unravelling existing standardisation agreements. As a result the MGO and his staff took a cautious line on the introduction of the M16, arguing against its universal adoption.[43] This was hardly sufficient to prevent it being issued in South East Asia but it did limit the possibility of adopting it in other operational theatres.

That said, the decision to buy M16s played an important part in shaping the approach taken by RSAF engineers (two of whom had been involved in the EM2 story) designing new prototype ammunition for the Section Small Arms Post 1980.[44] In the first instance this was because Borneo had demonstrated that the American fixation with the 7.62mm NATO standard was now coming to an end. It seemed that the future trend would be towards smaller calibre ammunition.[45] In the second, it was clear that the British Army was still keen to adopt ammunition that would be acceptable to the NATO powers. Guided by a desire to balance these two positions, designers at Enfield came to the conclusion that a round capable of striking targets out to greater range might still be necessary for European conditions. It appeared that, despite the evidence to the contrary, some in the Army still held on to the view that combat in the jungles had to occur at close ranges whilst engagements in Europe did not.

[41] Letter from MGO to CGS, 12th February 1965, DEFE 24/644, NA.
[42] Letter from DGofA to Under Secretary at the MOD, 23rd January 1961, DEFE 7/1325, NA.
[43] Letter from Assistant Secretary, ES1 to AEP, 12th March 1965, WO 32/20815, NA.
[44] Mr Metcalfe was lead engineer on the EM1 and Mr Hance was sent to the United States during the EM2 trials process in order to look after the weapon. Both were now leading the UK small arms engineering efforts at Enfield.
[45] Letter from Assistant Secretary, ES1 to AEP, 12th March 1965.

Within these parameters, then, Enfield engineers decided in the late 1960s to investigate ammunition within a range of 7mm to 5mm. As was shown in the last case study, the problems the British experienced whilst trying to persuade the Americans to agree to the EM2 after the Second World War suggested that investigating a round below 7mm (.280") would be more fruitful. At the same time 5.56mm had proved itself suitable for ranges up to 300 yards. Therefore, if longer range was still a requirement, not just for Britain but for all NATO powers, and the existing alternatives were unacceptable, it was understandable that the RSAF should decide to produce and extensively test a new prototype 6.25mm ammunition.[46] As far as Enfield was concerned this new ammunition would have achieved considerable weight savings for an insignificant loss of range and, if other events had not intervened in the 1970s, might well have been the ammunition Britain would have used in the SA80.[47] These ambitions were, however, upset by a new emergency that started in 1969: Northern Ireland.

Northern Ireland

If Borneo encouraged engineers to work on ammunition that might be suitable for both the jungle and the plains of Western Germany then the British Army's experience in Northern Ireland stretched weapons design in directions that had not previously been considered. For the troubles not only challenged the General Staff's thinking on civil-military relations but also helped generate new approaches to small unit tactics.[48] In turn this had an impact on the choices being made about small arms, ultimately leading to the decision to abandon 6.25mm ammunition and start work on a sub-5mm round called the 4.85mm. This new calibre was optimised for performance in a number of situations that betrayed the point that social groups

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[46] Dugelby, Modern Military Rifles: the EM2 Concept Comes of Age, pp. 21-24.

[47] In fact the RSAF reported that a 6.25mm round was 63% lighter than the 7.62mm NATO round as compared to 43% for the 5.56mm M16. Moreover, they stated that 6.25mm SAA was effective out to 600 metres compared to the 450m of the 5.56mm M16 ammunition, see, Ibid., p. 29.

[48] It is not the ambition of this chapter to explore the background behind the civil unrest in Northern Ireland except in so far as it helps to explain changes in tactics and equipment. For a more complete introduction into the history and strategy underpinning British involvement see, M. Dewar, The British Army in Northern Ireland, rev. 2nd edn., (London: Arms & Armour, 1996) and D Benest, 'Aden to Northern Ireland, 1966-1987', in Big Wars and Small Wars - The British army and the lessons of war in the twentieth century, H. Strachan (ed.), (London: Routledge, 2006).

beyond the Army, including those at the Home Office concerned with civil unrest, were having an impact on equipment selection.

Initially deployed to Northern Ireland in 1969 in defence of the Catholic community, the British Army's involvement in the province soon expanded as sectarian and political hostility increased. In 1972 at the height of the violence, 1853 bombs were discovered or detonated, nearly 400 people (from all sides including the Army) killed and over 10,000 shooting incidents were recorded.[49] However, this level of intensity was not sustained over a long period of time. With the introduction of internment in 1971 and following significant operations to restore official law and order to the 'no-go' areas of Londonderry and Belfast in 1972, the main Republican movement had been forced to withdraw to the border areas.[50] Any initial ambition of the Irish Republican Army (IRA) to show the world that Northern Ireland was not under the control of the British Government had failed. In the years that followed the IRA (and other affiliated Republican movements) could no longer sustain an open insurgency and were consequently forced into adopting more covert methods to prosecute what a 1977 Staff Report would describe as the 'long war'. This was reflected in the Republican movement's organisation structure which changed from that of a formal military hierarchy to one with a cellular configuration.[51] Whereas the former was appropriate for open warfare, the latter was more suitable for terrorist operations.

In the early days of the troubles, the British Army was poorly equipped to deal with the levels of street violence it experienced. Watched by the world's media, under legal restraint with regards to the use of firearms and armed with weapons more appropriate for high-intensity operations, infantrymen initially found the new environment difficult to deal with.[52] These problems were compounded by the tactics adopted by the Republicans during the opening phases of the troubles. The

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[49] Dewar, The British Army in Northern Ireland, p. 242.
[50] Benest, 'Aden to Northern Ireland, 1966-1987', p. 136.
[51] Ibid., p. 138-139.
[52] Dewar, The British Army in Northern Ireland, pp. 30-32 and p. 113 (see note).

favoured method of paramilitary gunmen was to use protest marches as cover for shooting at Army units engaged in riot control.[53] This presented company commanders and NCOs with an acute tactical dilemma. Managing angry mobs usually involved troops carrying riot shields and batons and standing in the open in such a way so that the protesters could not advance. In these circumstances troops were vulnerable to small arms fire. If, however, a unit took a tactical stance more suitable for an urban combat patrol then it would be difficult to police a mass of people. Understandably, then, mistakes could easily be made as soldiers had to decide whether a man in a crowd was just a protestor, a person spotting for a gunman or someone with more lethal intent.[54]

Clearly, in these circumstances the excessive use of force could prove counter-productive: undermining any support with the local population which the Army might need in order to carry out its allotted tasks. And in this respect a Home Office/Ministry of Defence working party on internal security was quick to note that in their view the SLR's 7.62mm ammunition could be especially deadly. This was because the, 'round will pass right through a man at short ranges', the implication being that one shot could kill the intended victim plus those standing behind or within ricochet distance.[55] In the context of civil unrest in Northern Ireland it was apparent that the existing service rifle was not sufficiently discriminate to enable its clinical use and avoid excessive casualties. This meant that the use of firearms had to be restricted and alternative ways found so that escalation could be effectively managed and unnecessary bloodshed avoided. This had led to CS gas being approved for use in August 1969 but the dilemma also stimulated the development of new equipment such as the 37mm non-lethal, baton round firing, Anti-Riot Weapon Enfield or ARWEN.

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[53] Benest, 'Aden to Northern Ireland, 1966-1987', pp. 131-132.
[54] M. Asher, Shoot to Kill: a Soldier's Journey Through Violence, (London: Cassell Military, 2004), pp. 130-132. According to Asher a combination of Army culture and peer pressure could also generate an overly aggressive outlook that could result in dangerous mistakes.
[55] See paper entitled 'Future Tactical Doctrine and Equipment Requirements for Operations in Support of the Civil Power', 31st July 1970, HO 325-132, NA.

Precautions, standard operating procedures and sensitive tactical deployment could not, however, rule out the use of firearms. In these circumstances, what was required was a rifle that was capable of more discriminate use by soldiers than the weapons at that time available in the inventory. Indeed, according to the Home Office/Ministry of Defence working party, the ideal solution would be the development of ammunition with, '...the same accuracy as afforded by the rifle (SLR) but which does not penetrate nor make a wound of dreadful appearance'.[56] Since the Second World War British engineers had been working on sub .30" calibre ammunition. Initially this had resulted in the EM2's 7mm round which for a variety of reasons discussed previously had been rejected. Following the fighting in Borneo ammunition design had focused on balancing jungle and European battlefield requirements leading to an investigation into a 6.25mm round. The fighting in Northern Ireland appeared to challenge this line of reasoning. Given that 5.56mm SAA had a reputation for lethality derived from experience in Vietnam and Borneo it hardly seemed feasible to develop ammunition with a larger bore. A more likely solution would come from investigating calibres below 5mm. Thus when a new General Staff Requirement (GSR 3518) was produced in 1974 outlining the requirements for section infantry weapons in the 1980s, the RSAF formally started its investigations into 4.85mm ammunition.[57] This, they believed, might make it possible for troops in Northern Ireland to to use their weapon more discriminately without compromising on lethality.[58]

However, developing the most appropriate ammunition would not, of and by itself, prevent collateral damage if troops remained poor shots.[59] Assaulting an enemy held position when engaged in a high-intensity conflict did not require particularly

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[56] Ibid.

[57] Operational Requirements Committee Section Small Arms Post 1980 (GSR 3518) – (Paper by the Army Department), 14th August 1974), p. 6.

[58] This was certainly the view of Monsieur Laloux who had been working with the British on the SLEM during the Second World War and the FAL during the EM2 debates, see Dugelby, Modern Military Rifles: the EM2 Concept Comes of Age, p. 46.

[59] Weapon handling and shooting were particular bugbears for Commanding Officers in Northern Ireland, see 'Survey of military opinion on current internal security doctrine and methods based on experience in Northern Ireland', Jan-Dec 1972, p. 9, DEFE 48/256, NA.

sophisticated marksmanship. By contrast, in a low-intensity, predominantly civilian environment skill at arms was essential if unnecessary casualties were to be avoided. Unlike the poor worker who blames his tools for his mistakes, discriminate shooting was not just about making sure that the man had the right level of skill to ensure he was fit to fire his weapon. On the contrary, and as recognised in GSR 3518, the type of equipment he was issued with played a significant part in shaping his proficiency.[60] A technical solution was needed therefore that did not, '...demand too high a degree of skill to ensure a successful engagement'.[61]

That is not to say that training the soldier to be a more effective battle shot was taken lightly. On the contrary it is quite clear that the Army took marksmanship very seriously as an examination of the *British Army Review* from the late 1960s and early 1970s will demonstrate.[62] That said, in 1975, both a new recruit and an average soldier in Northern Ireland were still someway short of the envisaged level of skill even after having completed their allotted ten hours training with a rifle.[63] A crucial indication of an infantryman's skill at arms was related to his ability to achieve a tight grouping of hits on a target when firing on the range.[64] And in this respect, whereas GSR 3514 stipulated that troops, whilst prone, should achieve a grouping of 4" at 100m, the reality was that they were only capable of producing a 10" group.[65]

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[60] See Annex C 'Specific Shortcomings of Present Infantry Weapons', found in Equipment Requirement for General Staff Requirement No. 3518 – Section Small Arms Post 1980, WO 188/2485, National Archive (NA).
[61] Ibid.
[62] S. G. Styles, 'Who is the best shot?' British Army Review, Vol: 27, (1967), Weeks, 'Keep it Small', D. J. Scott, 'In Defence of the SLR', British Army Review, Vol: 29, (1968), A. C. Elcomb, 'Training the Battle Shot', British Army Review, Vol: 34, (1970), T. W. Whittaker, 'The Service Rifle of the Future', British Army Review, Vol: 42, (1972), J. C. G. MacKinlay, '"Shoot to Kill" - An Assessment', British Army Review, Vol: 48, (1974), T. W. Whittaker, 'Moving Target Shooting', British Army Review, Vol: 47, (1974).
[63] Royal Small Arms Factory, Rifle Design Study Day, 20th January 1975, pp. 31-37, 121 Design of Weapons Box 1, MOD Pattern Room Archive.
[64] Elcomb, 'Training the Battle Shot', p. 24.
[65] Ibid., p. 31. The shooting skill of the Army had not significantly improved by the late 1970s either. See A. E. Stockley, 'Recruit Shooting Standards', Vol: 62, (1979), pp. 70-71.

Of course there were a number of ways in which the problems of poor marksmanship could be addressed. From a training perspective for example the pamphlet 'Shoot to Kill' introduced troops to the idea of the 'Personal Weapon'.[66] The cornerstone of this concept was the policy to provide each soldier with a firearm that they would then retain for as long as they remained with an infantry battalion. Not only would they train with the same rifle throughout their time with their unit but they would also take it on exercise and into battle. Individuals were both responsible and accountable for the weapon they were issued with and were expected to achieve and maintain a high degree of proficiency in its handling.[67] Training was, however, only one aspect of proficiency. If a technical solution could be produced that would contribute towards making it easier for the soldier to use his rifle discriminately then the training dilemma might be alleviated.

In this respect a number of contrivances could be developed to aid the soldier in his efforts to achieve a tight group of shots. In the first instance, the very length and weight of the SLR made it difficult to bring the weapon up to the shoulder to aim.[68] The result was that it was easier to shoot when lying down rather than when in a kneeling or standing position. Needless to say, circumstances in Northern Ireland did not always make this possible. Fighting in urban areas for example could involve close quarter battle inside buildings where shorter, lighter firearms would make it easier to move around rooms. In this situation RSAF engineers opted to build a bullpup rifle because in their view its advantages outweighed those of the SLR. The loss of a butt kept the weight down and shortened the weapon's overall length. On top of this, if the SLR's conventional iron sights were replaced with an optical sight then the shooter might be in a stronger position to pick out their target. Finally, it was well understood that the effects of excessive recoil energy left new recruits unwilling to embrace weapon handling.[69] A small calibre 4.85mm round

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[66] J. C. G. MacKinlay, '"Shoot to Kill" - An Assessment', Vol: 48, (1974), p. 45.
[67] Royal Small Arms Factory, Rifle Design Study Day, 20th January 1975, pp. 11-12.
[68] See 'Survey of military opinion on current internal security doctrine and methods based on experience in Northern Ireland', Jan-Dec 1972, p. 32, DEFE 48/256, NA.
[69] Royal Small Arms Factory, Rifle Design Study Day, 20th January 1975, p. 13; Weeks, 'Keep it Small', p. 14.

would produce less recoil which would consequently make it easier to train the infantryman in the use of their rifle.

That is not to suggest that the bullpup design was not without its disadvantages. In the first instance, for example, a lack of a butt meant that, like the EM2, troops had to rely on either an optical or iron sight raised above the barrel of the rifle in order to aim. This forced a soldier to expose his head to additional incoming fire as he sought to direct his shooting.[70] In the second, similar problems with over exposure to incoming fire could be generated by the way in which cartridge cases were ejected. Typically the ejection of a hot cartridge case from a bullpup rifle would be to the left or right of the weapon's receiver. As the user would be burnt by the spent ammunition it was only possible for them to use their firearm from one shoulder. Consequently, depending on whether cartridges were expelled from the left or the right of the receiver, a soldier could remain in cover and fire his rifle around one corner but would be unable to do the same for both.[71] In 1975, as only 11% of the British Army was left-handed, it was understandable why the Army decided to configure the SA80 for right hand use.[72] A kit had been created to enable the weapon to fire from the left shoulder but, according to a Parliamentary investigation, had been abandoned for logistical, cost and safety reasons.[73] Thus, depending on how one prioritised battlefield dilemmas, this would place soldiers in unnecessary danger and lead to a loss of tactical flexibility or alternatively provide them with a less cumbersome firearm.

Tactical drills and standard operating procedures could be developed to get around some of the problems produced by a bullpup rifle but in 1974 the prospect of a new Personal Weapon was not of and by itself stimulating new battlefield methods.

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[70] Raw, The Last Enfield: SA80 - The Reluctant Rifle, p. 198.
[71] H. P. M. Chambers, Captain, 'Bullpup - A Grass Roots Assessment', British Army Review, Vol: 61, (1979), pp. 27-29, Raw, The Last Enfield: SA80 - The Reluctant Rifle, p. 195.
[72] 'The SA80 Rifle and Light Support Weapon, Report together with the Proceedings of the Committee relating to the Report, Minutes of Evidence and Memoranda', (London: HMSO, 1993), p. 3.
[73] Ibid., p. 30.

Rather, the need for force protection in the context of an effective Republican campaign to shoot British troops was fuelling alternative combat techniques.[74] For example, when the Army arrived in Northern Ireland the infantry used, as one commentator described it, the 'duck' approach to patrolling.[75] This method involved patrol members walking in a line, one man following another, whilst the leading and ending soldiers provided security for the rest of their section. Reliant on the wits and observation skills of just two men, gunmen could wait for the leading member of the patrol to pass before firing on soldiers in the middle or rear of the line. Given that the IRA preferred to engage troops and then escape without being detected, this method of patrolling did not provide sufficient force protection for troops.

With casualties mounting it was decided by the General Officer Commanding to establish a Northern Ireland Training Advisory Team charged with developing tactics to overcome the threat from the IRA and to assist in training units.[76] After observing the existing methods, the team evolved an approach to patrolling that provided more force protection. The result of these investigations was the development of a system based on splitting the eight man infantry section into two, four man teams. These four man teams were known as 'bricks', any number of which could be combined to form a 'multiple' to meet a range of tactical requirements. Commanded by corporals or lance corporals, each member of the team would observe and cover a quadrant down the patrol's line of advance thereby providing 360 degree observation of the surroundings. With several of these bricks working inter-dependently along similar axes and communicating by tactical radio, the approach provided the building block for more secure and effective combat patrolling.[77] In particular by a process of rotating the 'multiples' like a satellite across the route of the patrol the IRA could never be quite certain where the next

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[74] Interview with Major-General Colin Shortis, Topsham, 7th January 2008.
[75] Ibid.
[76] Ibid.
[77] Ibid.; A. Bain, 'The Infantry Section: Lifting its Capability', RUSI Defence Systems, Vol: 10, No: 1 (2007), p. 87.

soldier might appear from. This in turn made them less inclined to take a passing shot.[78]

But whilst it might be a step too far to suggest that these innovations had a direct bearing on the small arms decisions being made in the early 1970s, it is fair to argue that the four man brick lent itself to a complete change in the equipment mix of the infantry section.[79] Indeed, conceptually speaking, the developments were not dissimilar to the thinking advocated by Major-General Wilson and the Battle School movement during the Second World War. The brick could be applied to the difficult problems faced by troops engaged in Northern Ireland or scaled up for use in conventional operations where principles associated with fire and movement might be more appropriate. When fighting a high-intensity engagement, for example, a multiple could act as a fire team, suppressing an enemy position with small arms fire whilst allowing its counterpart to advance to close quarters. Alternatively, one team could shoot at the enemy allowing the other to leapfrog to another position from where they themselves could open fire thereby making it possible for the infantry section to advance under cover of small arms. That said, where there was a difference in attitudes between the 1970s and the early 1940s was in relation towards selective fire weapons. GSR3514 now accepted that a rifle with continuous fire capability needed to be issued to every infantryman. Consequently, each brick would be capable of generating the same quantities of fire and could more easily provide mutual support to each other. The tactical flexibility envisaged by the EM2 advocates could become a reality.

Where the decision to adopt an infantry organisation structure based on the brick did have ramifications was in respect of the decision to adopt the LSW in 1986. The LSW was intended to replace the Bren LMG and the light role GPMG. Since the Second World War, the infantry section had been armed with only one of these weapons. With the evolution of the brick structure, however, it became clear that it

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[78] Interview with Major-General Colin Shortis, Topsham, 7th January 2008.
[79] Bain, 'The Infantry Section: Lifting its Capability', p. 87.

might be tactically more appropriate to have two support weapons per section. With both fire teams possessing a LSW the quantity of fire available would be balanced between each fire team. As a result the leapfrogging advance would be easier to orchestrate, especially whilst under fire. Moreover, because the LSW utilised the same ammunition and magazine as the SA80 but remained lighter than both the Bren and the GPMG, it was viewed as ideal for operations outside NATO where weight of fire was an important element in small unit tactics but mobility and logistical constraints were a limiting factor.[80] By implication then, if only one of the two bricks had an LSW then the ability of the section to fire and move forwards by mutual support, one fire team at a time, would be restricted. The Director of Infantry was consequently of the opinion that both fire elements in the section had to have a support weapon.[81]

Where the Director of Infantry's plans came unstuck was in relation to the poor reliability of the LSW designed by the RSAF.[82] Unfortunately for the DInf the amount of time, effort and organisational capital invested in developing the LSW made it exceptionally hard to abandon the weapon in favour of something else.[83] If the LSW had been sufficiently reliable this would not have been a problem.[84] However, with the LSW's reliability in some doubt, the DInf had to decide whether he would buy a commercial off-the-shelf weapon or accept the RSAF's assurances.[85] If the DInf opted for the former then he could only afford one support weapon per

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[80] Other NATO powers like West Germany preferred to use a heavier, belt fed machine gun like the MG42 re-chambered to fire NATO 7.62mm ammunition. Suitable for troops who could rely on motorised transport, this weapon (eventually renamed the MG3) was appropriate for troops that did not need to fight out of theatre. See J. Weller, 'The West German MG42-59 and its Influence on Tactics', British Army Review, Vol: 27, (1967), pp. 18-19.

[81] Interview with Major-General Colin Shortis, Topsham, 7th January 2008; Interview with Lieutenant-Colonel Tony Briard, Warminster, 24th May 2007.

[82] Interview with Major-General Colin Shortis, Topsham, 7th January 2008.

[83] Interview with Major-General Colin Shortis, Topsham, 7th January 2008.

[84] Ibid.; Raw, The Last Enfield: SA80 - The Reluctant Rifle, pp. 91-95.

[85] The next most attractive LMG was the 5.56 FN Minimi. Continuing problems with the LSW eventually resulted in it being used in a different role. The equipment make up of the brick is now: 2 SA80s one equipped with an under-slung grenade launcher, an LSW for long range suppressive fire and a folding stock FN Minimi, used in the LMG role and known in the British Army as the L110A1 Para, see http://www.army.mod.uk/infantry/current_equipment/the_infantry_small_arms_in_the_section.htm (website visited on the 21st February 2008).

section.[86] If, however, he opted for the LSW and the reliability problems could be resolved then the infantry would have the balanced fire-teams the DInf believed it needed. In the end the DInf opted to accept the guarantees provided by the Enfield engineers and decided to buy the LSW.[87]

West Germany

If Northern Ireland represented a demand from some quarters for a more discriminate, surgical firearm and Borneo demonstrated the importance of lighter firearms with continuous fire capability then West Germany was about high-intensity manoeuvre warfare. Typically this type of high-intensity fighting involved the use of tracked armoured vehicles necessary for protecting and transporting infantry around the battlefield. The socio-technical considerations associated with this approach to engagements created their own tactical and technical problems. But what complicated design considerations in this scenario more than others was not so much the battlefield dilemmas faced by troops in the field but political considerations associated with working as part of an alliance structure. In particular, the problems associated with standardising equipment could be especially troublesome for engineers and users alike. Indeed, 4.85mm SAA might have been appropriate in Northern Ireland but if the wider priorities of NATO were to be accommodated within a new class of ammunition then RSAF engineers would have to consider questions beyond the interests of the British Army. In this respect, Britain's strategic commitment to NATO defined the context within which small arms design choices were being taken.

With the conclusion of the Second World War, Britain left two divisions in Western Germany as an occupation force. By 1954, amendments to the Brussels Treaty committed Britain to leave 55,000 men in Germany until 1994.[88] This force, known as the British Army on the Rhine (BAOR) was comprised of the 1 British Corps (1(BR) Corps) which, alongside German, Dutch and Belgian Corps, constituted

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[86] Interview with Major-General Colin Shortis, Topsham, 7th January 2008.
[87] Interview with Major-General Colin Shortis, Topsham, 7th January 2008.
[88] McInnes, Hot War Cold War - The British Army's Way in Warfare, 1945-1995, p. 53.

NATO's Northern Army Group.[89] Initially, the General Staff's thinking on how to deploy the BAOR was conditioned by financial stringency and the availability of nuclear forces.[90] In this context it was readily accepted by the Staff that NATO's armies mainly acted as a tripwire for the early use of atomic weapons. This in turn created little incentive for the British government to go to the trouble of creating proficient and well-armed military formations.[91] As a result the British Army placed a greater emphasis on the tactical use of firepower over manoeuvre; were unwilling to produce formal operational doctrine; relied on highly competent troops to make up for a lack of equipment; and made little effort to integrate with the military practices of other NATO allies.[92]

Prior to 1967, NATO had relied on early use of nuclear forces to deter Soviet aggression in Europe. With the adoption of a strategy of flexible response the massive use of nuclear weapons was not envisaged as the first retort to an invasion of West Germany. Consequently, this placed a considerable premium on the credibility of NATO's conventional armies: they had to seem capable of withstanding an assault by the Warsaw Pact. By the early 1970s the British Army's response to this new strategic posture involved the use of a mobile linear defence. Under this plan 1(BR) Corps would be arranged in two echelons. The forward group of two divisions deployed on the inner German border would hold defensive positions until forced to withdraw through the second line whereupon they would regroup ready for further action. At the tactical level armoured vehicles such as the AFV 432 could transport an infantry section to the area that needed to be held at which point troops would dismount and fight from prepared positions.[93] In addition there was a demand for increasingly effective anti-tank weapons so that the infantry could play a role in parrying initial Soviet armoured thrusts.[94] This would allow

[89] Ibid., p. 54. The Central Army Group was responsible for the defence of southern Germany and comprised two West German and American Corps backed by a French Corps which stood out of NATO's unified military command structure.
[90] Ibid., p. 55.
[91] J. Strachey, On the Prevention of War, (London: Macmillan & Company, 1962), pp. 106-107.
[92] McInnes, Hot War Cold War - The British Army's Way in Warfare, 1945-1995, p. 56.
[93] Role of infantry in the 1 (BR) Corps battle 1970-1975,p. 5, DEFE 48/217, NA.
[94] Ibid., pp. B1-B4.

British tanks to be concentrated and made ready for battle group-sized counter attacks.[95]

Throughout the 1970s the General Staff continued to adapt these plans to take into account increasing Soviet conventional strength and a relative decline in British military equipment levels.[96] By the close of the decade, however, it appeared increasingly likely that Soviet armed forces might be in a position to overwhelm NATO with a conventional surprise attack.[97] If this was the case then, to appear credible, NATO's armies would have to re-evaluate their approach to defending West Germany.[98]

Whilst there were a number of ways in which the military credibility of NATO might be sustained and a Soviet invasion dissuaded, two ideas in particular had implications for small arms design. The first involved trying to stave off the total decline of conventional armed forces by reinvigorating a strategy that had originally been adopted by the emerging NATO powers during the early 1950s. The central plank of this method was to try and stretch the limited defence budgets of the various member states as far as possible by standardising equipment. Traditionally, armies had procured whatever systems they needed based on criteria that some commentators have suggested were related to national interest.[99] With the creation of NATO the hope was that through a degree of central planning, members would cooperate in such a way as to ensure that there was no duplication either in research or manufacturing effort. This would ensure that the maximum military potential could be generated from those resources that were available.[100] The previous EM2 case study has shown how fraught that process could be and it could come as no

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[95] McInnes, Hot War Cold War - The British Army's Way in Warfare, 1945-1995, pp. 56-57; see also 'Summary of 1(BR) Corps Concept of Operations – The Role of Mechanised Infantry (Summary of ECAB/P(74)/4 of April 1974)', WO 194/1332, NA.
[96] Ibid., pp. 58-59.
[97] Ibid., p. 60.
[98] General E. Bramall, 'British Land Forces: The Future', RUSI: Royal United Services Institute for Defence Studies, Journal, Vol: 127, No: 2 (1982), p. 17.
[99] K. Hartley, 'NATO, Standardisation and Nationalism: An Economist's View', Vol: 123, No: 3 (1978), p. 57.
[100] General E. Bramall, 'British Land Forces: The Future', Vol: 127, No: 2 (1982), p. 22

surprise that by the mid-1970s the majority of standardisation agreements had failed to pay any significant dividend to those who were most passionately promoting them.[101]

However, the re-emerging Soviet threat in the 1970s drove home the point to many planners that more effort was required on the standardisation front. One area that many had initially believed to be simple but that had proved to be extremely hard to resolve was related to ammunition standardisation. By 1967, the Americans had decided to adopt 5.56mm ammunition even though the rest of NATO was still using 7.62mm[102]. By the early 1970s it was well understood in British military circles that this incongruous situation would be resolved in a new round of NATO standardisation agreements (STANAG) to be held in 1978 and 1979.[103]

The significance of this for those groups committed to the development of 4.85mm ammunition was that these trials could force the British Army to accept a round unsuitable for operations in Northern Ireland. The Vice Chief of the General Staff (VCGS), for example, had indicated that he would prefer to make the decision on ammunition based on an internal security scenario but this option was constrained by the next round of STANAG trials.[104] Given the strategic commitments of the British government to NATO, the outcome of the STANAG trials would, therefore, have a direct bearing on the calibre of the weapon replacing the SLR. Accordingly, when in 1979, the trials resulted in agreement to adopt 5.56mm ammunition, the Army and the RSAF had to accept that, despite the qualities of the 4.85mm ammunition, non-technical factors had shaped the debate so as to prevent the selection of a round optimised for British circumstances.[105] The Section Small Arms Post 1980 would

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[101] K. Hartley, 'NATO, Standardisation and Nationalism: An Economist's View', Vol: 123, No: 3 (1978), p. 57.
[102] McNaugher, The M-16 Controversies – Military Organisations and Weapons Acquisition, pp. 127-128.
[103] See, Operational Requirements Committee Section Small Arms Post 1980 (GSR 3518) – (Paper by the Army Department), 14th August 1974.
[104] Letter from AD/M to unknown, entitled: 'Small Arms for the '80s', 16th July 1974, WO 188-2485, NA.
[105] Raw, The Last Enfield: SA80 - The Reluctant Rifle, p. 229.

have to fire 5.56mm SAA if NATO standardisation agreements were to be maintained.

This debate on standardisation was not, however, the only factor that affected thinking on the replacement for the SLR. A renewed emphasis on operational doctrine also played its part in shaping the way in which small arms were being considered by the British Army. If, as was becoming increasingly clear, the Army had insufficient resources to hold West German territory in either depth or strength then overwhelming Soviet conventional forces might brush aside a relatively static defence built around the tactical use of firepower and attrition.[106] In this situation greater mobility would allow NATO forces to confront and defeat enemy thrusts in detail one (or more) at a time so long as sufficient strength could be amassed at the right place and time. This could only be achieved, however, if the Alliance command structure could act and react more quickly than the enemy. By highlighting manoeuvre and initiative the ambition was to get inside the enemy's decision-making cycle by operating at a higher tempo.[107] By elevating manoeuvre warfare to the operational level, a greater emphasis was placed on the need for a coherent plan of operations at Corps and Army commands, the ambition of which was to provide NATO with sufficient forces to deliver a counter strike and regain lost territory.[108]

From an equipment point of view, these ideas shaped the thinking of various members of the General Staff, enabling them to identify different ways of seeing the battlefield and helping them to define appropriate technical solutions. Consequently, it had been decided to replace the AFV 432 with a new fighting vehicle. This Mechanised Infantry Combat Vehicle (MICV) not only provided a safer means of transport but was also intended to engage with the enemy whilst taking the infantry

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[106] McInnes, Hot War Cold War - The British Army's Way in Warfare, 1945-1995, p. 61.
[107] Ibid., pp. 60-64.
[108] Ibid., pp. 64-68.

right onto their objective.[109] The MICV was armed with a 30mm Rarden cannon which had been designed to engage armoured fighting vehicles (AFV) that carried infantry. This made it possible for the MICV to fight its way on to the objective at high speeds before debussing troops into close quarter battle.[110] Furthermore, as the MICV was equipped with a 7.62mm Hughes Chain Gun it could provide covering fire for infantrymen as they left their vehicle.[111] In these circumstances the ability of the infantry to get out of the MICV quickly and with their Personal Weapon already up to their shoulder might prove essential if they were to survive the initial contact with the enemy. At the same time, small arms with long range capability would prove unnecessary. These considerations clearly had implications for RSAF engineers and MICV designers alike.

For the AFV designer, the demand for operational tempo meant that mechanised infantry had to carry all their equipment with them putting a premium on stowage space.[112] At the same time, if speed was essential then it was important that troops could leave their vehicle unimpeded. This meant that the debussing hatch had to be sufficiently large to allow a man, his combat kit and rifle out through the door with relative ease.[113] For the small arms engineer the successor to the SLR had to be short, handy and easily stowed whilst enabling the infantryman, once out of his vehicle, to provide suppressing fire quickly so that his colleagues in the section could disembark relatively safely. None of these requirements necessarily conflicted with the demands of fighting in Northern Ireland. On the contrary, the EM2 had shown that a rifle that allowed soldiers to move freely within confined spaces combined with the ability to generate aimed fire at fleeting targets was not

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[109] Bramall, 'British Land Forces: The Future', pp. 21-22. The MICV was eventually known as the MCV80. See also 'General Staff Requirement No. 3533 (revised August 1976)', WO 188/2176, NA.
[110] Interview with Major-General Colin Shortis, 7th January 2008. The role of mobility is discussed in K. S. Brower, 'Armoured Fighting Vehicles and Units for the Future', JRUSI, Vol: 126, No: 3 (1981), p. 66.
[111] J. P. Riley, 'MCV-80 and Beyond - Implications for the Infantry', Vol: 131, (1986), p. 24.
[112] See also 'General Staff Requirement No. 3533 (revised August 1976)'.
[113] The size of the rear exit hatch on the FV432 is 0.9m wide by 1.13m high. By contrast the Warrior MICV has a hatch 1m wide by 1.2m high. Many thanks to Richard Strickland for providing these figures. GSR 3533 stated that the MICV hatch was to be no smaller than that found on the FV432. See, 'General Staff Requirement No. 3533 (revised August 1976)'.

technically incompatible with a weapon designed to produce larger volumes of fire appropriate for close quarter battle.[114] A bullpup design replacement for the SLR could therefore satisfy the demands of a number of different interest groups within the Army.

Conclusion

In the first instance this case study demonstrates that there was nothing inevitable about the form and selection of the SA80. Several non-technical factors shaped the decision to choose both the 5.56mm ammunition and the SA80 and LSW. This was indicative of a number of different social groups with differing perspectives on the battlefield problem defining their preferred solution differently. Borneo demonstrated the importance of lighter firearms with a continuous fire capability. Northern Ireland showed that troops capable of aimed, discriminate fire were necessary. West German requirements were for weapons that were easily stowed within a vehicle and which would not hinder debussing. None of these scenarios was necessarily incompatible with each other but all three environments inspired different constituencies within the Army to develop particular views of the infantry battle. As a result it was possible for them to conceive of a number of technical responses to each situation.

Where a common perspective did emerge, however, was in relation to the range at which engagements would occur. Second World War evidence that most infantry combat took place at ranges below 300 yards could still be disputed by some but in the battlefield interpretations described here this did not dominate the development agenda. The reason for this was that small arms were important only in certain circumstances. In mechanised warfare, for example, the MICV could fight its way onto the objective and debus infantrymen into close quarter battle. Anti-tank weapons and sustained fire GPMGs could be relied on during missions to hold ground. With regards to urban warfare, the range at which troops needed to engage

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[114] Infantrymen are now trained to switch their Personal Weapon from single shot to continuous fire when they are in the final throes of the assault. Interview with Lieutenant-Colonel Richard Jones, Leeds, 18th January 2007.

terrorists or insurgents was limited by buildings and other sight-impeding objects. In the jungles, range was necessarily circumscribed by the foliage. Whereas in previous case studies, engagement range had been an important consideration for a number of relevant social groups, by the time a replacement for the SLR was being considered the issue was no longer the defining concern because tactical considerations made it less important.

Instead, the features of the SA80 and LSW gave each of the various interested parties something they believed they needed. A bullpup design meant a lighter and handier weapon. Selective fire capability using a smaller calibre round ensured that troops could adopt fire and movement tactics without compromising existing logistical arrangements. An optical sight provided a solution to the need for a discriminate weapon capable of clinically engaging insurgents. And underpinning all of this the adoption of 5.56mm ammunition ensured that NATO STANAG agreements were maintained without compromising on either wound ballistics or range requirements. The success of the Section Small Arms Post 1980 can, therefore, be put down to the way in which it addressed the concerns of various relevant groups by allowing them to prioritise their battlefield problems in a manner that suited them. And it is this interpretive flexibility, irrespective of the production problems subsequently experienced, that is indicative of the weapon's success.

Chapter Eight - Conclusion

Technological determinism and the Social Construction of Technology

This thesis examines why British infantry rifles have taken the form that they have. This is achieved by applying a method derived from the Social Construction of Technology (SCOT) identifying not only the key actors and relevant social groups who have an interest in these weapons but also exposing their views on battle. What has emerged is how different parties interpret combat problems differently. This shows that the expectations made of infantrymen were not identical across any of the four case studies and that any socio-technical responses developed had to adapt to the particular situations that were being faced. Consequently the way that the British Army has sought to solve its battlefield dilemmas has been neither inevitable nor predictable but rather dependent on the specific social choices and contextual circumstances the various interest groups have found themselves in at any one time.

This contrasts neatly with more conventional approaches to military technology associated with the field of study known as the Revolution in Military Affairs (RMA).[1] Broadly speaking, according to this line of reasoning, the relationship between the offence and defence in battle stimulates new kinds of weaponry. If one adversary has a certain type of war-winning equipment then the other side has to develop a technical response that will negate its effects. Armed forces have to adapt their tactics and modify their organisational practices in order to maximise the

[1] An excellent introduction to the field of study associated with the RMA can be found in M. Knox and W. Murray (eds.), The Dynamics of Military Revolution, 1300-2050, (Cambridge: Cambridge University Press, 2001). Examples of work undertaken by the main historians of the RMA include, G. Parker, The Military Revolution: Military Innovation and the Rise of the West, 1500-1800, (Cambridge: Cambridge University Press, 1988); J. Black, A Military Revolution? Military Change and European Society, 1550-1800, (London: Macmillan, 1991); C. J. Rogers (eds), The Military Revolution Debate: Readings on the Military Transformation of Early Modern Europe, (Princeton, NJ: Princeton University Press, 1992). For an indication as to how the historical RMA literature can be applied to contemporary socio-technical problems see, C. J. Rogers, '"Military Revolutions" and "Revolutions in Military Affairs": A Historians Perspective', in Towards a Revolution in Military Affairs? Defense and Security at the Dawn of the Twenty-First Century, T. Gongora and H. Riekhoff (eds.), (London: Greenwood Press, 2000).

potential advantage they might get from this new armament.[2] Those that fail to understand the full implications of this new technology face the risk of defeat in battle. Underlying these claims is the technological determinist's view that weapons follow a developmental trajectory along a fixed course towards ever more advanced and advantageous configurations.[3]

This thesis, however, has attempted to demonstrate how a military technical artefact, like those civilian technologies examined in the literature on the Social Shaping of Technology (SST), does not conform to these deterministic forms of analysis. Indeed, with regards to the four rifles described here, the suggestion that their design was purely concerned with smoothing out engineering problems in order to achieve a more efficient killing machine is not borne out by the evidence. On the contrary, there was no single defining characteristic that required some sort of improvement towards an ideal form of weapon. Rather the successful rifle was the one that could accommodate a number of differing interpretations within it.

At the same time, the proposition that military victory can be achieved by the Army that understands how to best make use of the equipment it has and adapts itself accordingly, is not supported by the evidence provided by these case studies either. On the contrary, the rifle that was successfully adopted invariably left the tactical and organisational questions posed by its selection open for further debate. Indeed, the one thing that these weapons did not do was compel any one group to accept the techniques of another.

[2] For a review of the RMA debate in the 1990s see, C. S. Gray, Strategy for Chaos – Revolutions in Military Affairs and The Evidence of History, (London: Frank Cass, 2002), pp. 1-20. The importance of the RMA logic is demonstrated by the way in which it has shaped discussions in US military circles. In this respect Andrew Krepinevich's article on the RMA is particularly important, especially given his affiliations with the Pentagon's Office of Net Assessment. See A. Krepinevich, 'Cavalry to Computer: The Pattern of Military Revolutions', The National Interest, Vol: 37, (1994).

[3] For a critique of the RMA line of reasoning see J. Stone, 'Technology, Society, and the Infantry Revolution of the Fourteenth Century', The Journal of Military History, Vol: 68, No: 2 (2004); and J. Stone, 'Technology and War: A Trinitarian Analysis', Defense and Security Analysis, Vol: 23, No: 1 (2007).

The measure of a weapon's success, therefore, can be defined by the way in which all the relevant social groups find what they want within it. For example, developing a bolt action magazine rifle did not necessarily result in a more destructive firearm; this was contingent on the wound ballistics of the ammunition and the probability of striking a victim. What it did make possible was the potential to cause more casualties more quickly. Any increase in this respect, however, was entirely dependent on whether the weapon was used in a particular way. With regards to the Lee-Metford (LEME), the evidence indicates that the ambition to produce greater volumes of fire was not by itself driving its adoption. Instead it had to appeal to four social groups with distinct views of the battlefield. The traditionalists wanted to continue to fire shots in volleys by rank. The Royal Navy were interested in a weapon that would enable their Marines to repel boarders and engage an enemy located in the fighting tops of ships. The imperialists were wary of the logistical implications that stemmed from a magazine rifle but recognised the need to adopt skirmishing tactics. At the same time the light infantry wanted a rifle that would allow them to match the fire capabilities of the heavy infantry. Underpinning each of these preferences were perspectives on battle that were not mutually incompatible. The success of the Lee-Metford could therefore be put down to the way in which it allowed each party to do what it wanted with the weapon without compelling any one group to adopt the techniques of the other. The LEME was not selected because it smoothed out engineering problems associated with the inefficiency of the Martini Henry but because it offered each of the actors a solution to a problem they believed needed solving.

Similarly, the Short Magazine Lee-Enfield (SMLE) was not simply about improving the initial design of the LEME. This is because the battlefield dilemmas that the SMLE was intended to solve were different from those of the LEME, reflecting the point that a new group of actors, the Indians, became involved in weapon selection. This group had another perspective on battle, one which reflected their experience of warfare on the North West Frontier. Consequently, they emphasised qualities in the SMLE associated with weight, handiness and the need to encourage the infantryman to use his own initiative when firing his weapon. Technical contrivances that hindered the soldier in the independent selection of his own target were removed. It was recognised that encouraging the man to shoot was more important than ammunition conservation.

Moreover, that the SMLE could also get selected, despite the hostility between the cavalry and the Indians, only serves to highlight the contingent nature of rifle development. After all, there was every possibility that the distrust between these two factions could spill over into the design parameters of the SMLE which in turn would feed into the decision to adopt it. That it did not is a sign that the two sides could find technical solutions to their particular problems without having to accept the battlefield tactics of one group over those of the other.

Finally, that the SMLE sceptics could do little to upset the Indians and the cavalry in their ambition to select a new rifle says much about the way in which a reliance on certain sources of information hindered their ability to put together an alternative perspective on the technical problem. In the case of the SMLE, the terms of the debate had already been shaped by members of the Army. Dependent on officers who believed that the SMLE represented the most appropriate rifle to replace the LEME, sceptical politicians and members of the NRA found it difficult to redefine the problem using different language. As a result they were ultimately locked into a discourse that led them to the sorts of conclusions deemed appropriate by the Indians and the cavalry school. Design stabilisation occurred through a process of rhetorical closure.

Comparable remarks can be made in relation to the Section Small Arms Post 1980 (SA80). In the run-up to the selection of the weapon there were three potential design solutions, each reflecting a different interpretation of the battlefield. Borneo demonstrated the importance of lighter firearms with a continuous fire capability. Northern Ireland showed that aimed precision fire was necessary. West German requirements were for weapons that were easily stowed within a vehicle and which would not hinder debussing. None of these scenarios was necessarily incompatible with each other but all three environments inspired different constituencies within the Army to develop particular views of the infantry battle. At the same time the technical solution arrived at served to accommodate all three forms of warfare without restricting the various tactical responses deemed necessary by the various actors involved. In this respect the SA80 did not force the Army to adapt its organisation structure in any one way but instead kept open a variety of solutions to the relevant social groups involved.

Of the four case studies, however, it is the EM2 story that fundamentally demonstrates the flaws in the technological determinist position. If rifles evolved towards more destructive forms on the basis of their own inherent logic then the EM2 should have been accepted into service without any argument. That it did not get selected does therefore throw considerable doubt on the notion that weapons have a fixed trajectory towards ever more advanced configurations. At a theoretical level, if the creation of one system does not lead inexorably to the introduction of the next then the determinist argument has to allow that other factors influence equipment selection. At the empirical level, the evidence shows that the Army waited another thirty-five years before adopting a fully selective fire weapon which, in turn, underlines the point that technical innovation is socially contingent.

In establishing this point the SCOT methodology underpinning this thesis has, just as was intended, demonstrated considerable merit. Not only has it helped to avoid technological determinism but it has also opened up new ways of looking at the equipment selection process. In this respect SCOT has been a useful way of breaking into the plethora of issues involved in explaining why the British Army's rifles have taken the form that they have. Whereas design stabilisation in the other case studies occurred as a result of rhetorical closure, the EM2 example shows how different interpretations of the battlefield problem had to compete with the organisational priorities of other relevant groups. As the EM2 advocates came together to argue for a weapon to replace the SMLE, another wider network of interest formed, reinterpreted the problem and sought alternative technical solutions based on a different frame of reference.

As far as the EM2 advocates were concerned a future rifle had to provide infantrymen with the kinds of tactical flexibility that they had not previously enjoyed. Underpinning the British perspective was the notion that the vast majority of engagements occurred at below 300 yards range and that smaller, faster bullets were sufficiently lethal. At the other end of the debate, the Americans remained wedded to the idea that marksmanship skills, aimed fire and hitting targets out to 2000 yards were important elements in battle and that only larger calibre rounds could impart sufficient kinetic energy to produce a kill at such ranges. In the context of equipment standardisation between the UK and the US, the solution that was being proposed by the EM2 advocates had to be capable of bridging both of these positions. That it could not was not just the result of a technically challenging brief. The source of the problem lay with the fact that the Americans and British had views on infantry combat that were fundamentally at odds with each other. This coloured all the discussions between the actors, crept into the various test plans and at the end of the day could not be resolved by the science of wound ballistics.

This becomes apparent when examining how powerful actors shaped the terms of the discussion in such a way as to skew the argument to favour their particular perspective. With access to their own sources of information and experimental data, the Americans, for example, could produce points of view that contradicted the EM2 advocates. This could then be used to sway sceptical actors who were uncertain about whether the British solution solved their specific battlefield problems. In this situation, where the technologies had yet to stabilise, the 'facts' were literally being put together by the engineers involved. Consequently, if one side in the debate appeared to have an advantage over the other then designers could change their system in an attempt to outbid their rivals. Selection was not simply a case of comparing finished products and picking the one that matched the criteria. Both the criteria for choosing a rifle as well as the rifle itself were open to reinterpretation depending on the actors' frame of reference. In this respect, the effectiveness of the American argument can best be demonstrated by the way in which they convinced wavering actors to accept the use of selection criteria that favoured their own solutions. That the EM2 advocates ultimately failed in their endeavour might, therefore, more reasonably be explained by their lack of powerful allies than with the soundness of their reasoning.

What SCOT successfully does, therefore, is to show how the various actors weight their technical priorities in relation to each other. This in turn helps the researcher to unpick why some decisions are reached in the way that they are. In this way, matters associated with the battlefield can be related to organisational concerns and alliance politics. In terms of British rifle design what this shows is that the locus of technical innovation is not fixed at either the top or the bottom of the organisation but can range from the general all the way down to the individual soldier, taking into account scientists and intermediary managers. What drives these changes, however, is not some autonomous machine but the concerns of human beings. SCOT recognises this and provides the tools to help explain why technologies take the form that they do.

Implications and future research directions

The central ambition of this thesis has been to show why the British Army's rifles have taken the form that they have whilst showing that technological determinism does not explain technical choices. By applying SCOT to the development of military equipment a conceptual ground clearing exercise has been achieved. This has challenged the received view that technology conforms to its own logic. Instead SCOT shows that weapon systems reflect the way different actors within the armed forces choose to fight. In this respect technical choices not only mirror how the battlefield is understood by groups within a military organisation. They are also statements about the way in which they want the battlefield to be. This has profound ramifications not only for those involved in technology innovation but also for those involved in thinking about strategy.

In many ways the study of strategy and technology appears to lead in two opposite directions. The Social Shaping of Technology (SST) literature shows how technical artefacts do not follow fixed developmental trajectories and do not have pre-determined effects. In contrast, strategists are seeking to produce specific outcomes whilst limiting uncertainty. They do this because they want to know that when they recommend an activity certain results will follow. Any approach to the study of technology that undermines this goal does not help limit ambiguity. Accordingly strategists tend to reify weaponry, to define what it can and cannot do, so that they can find ways of achieving particular military objectives.[4]

By way of contrast, SST serves to remind the strategist that the way the world looks does not necessarily mean that it is that way. That the world might be viewed differently is clearly illustrated by military historians and psychologists who have observed that the closer one steps to the battlefield the harder it becomes to objectively establish what happens there.[5] This is not just a result of competing historical interpretations about the nature of 'real war' but also a matter of human psychology. Indeed, the very language used to describe both combat and the enemy is replete with terms that demonstrate both the raw emotional and psychological trauma that result from fighting as well as the prejudice and denial necessary to make such acts even conceivable.[6] The ability to construct interpretations of the battlefield does, therefore, very much depend on who has come away from it alive and the extent to which they are willing to socialise their experiences of war with others.

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[4] J. Stone, 'Technology and War: A Trinitarian Analysis', Defense and Security Analysis, Vol: 23, No: 1 (2007), p. 28.

[5] R. Holmes, Acts of War: the Behaviour of Men in Battle, (London: Weidenfeld & Nicolson, 2003), p. 152; Griffith, Forward Into Battle: Fighting Tactics from Waterloo to the Near Future, p. 5; J. Keegan, The Face of Battle, (London: Pimlico, 1995), pp. 15-78; Grossman, On Killing: the Psychological Cost of Learning to Kill in War and Society.

[6] Grossman, On Killing: the Psychological Cost of Learning to Kill in War and Society, pp. 91-93.

By examining the way that these experiences gain meaning within a community, constructivism can show how some interpretations of battle become more persuasive than others. In this respect, the SST agenda not only underlines the central argument advanced by the later Wittgenstein that 'meaning is use'[7] but also, in its exploration of the sociology of knowledge demonstrates the validity of Foucault's contention that truth and power are intimately intertwined.[8] When trying to determine how technology is understood, therefore, it is important to be aware of the process by which one narrative becomes more acceptable over another. Such clarity helps to disentangle the various views of the battlefield that are projected onto weaponry and develop a deeper understanding as to the structures of power within a military organisation.[9]

Exploring the way in which representations of the battlefield are constructed does therefore have implications for the technologist and strategist alike. Different approaches to both weaponry and strategy are possible because warfare could be described in different terms. At the level of weapon design, this issue is important because the way soldiers think about and portray their experiences of war shapes the technical responses developed to overcome battlefield problems. For the researcher trying to understand why military equipment takes the form that it does, this complication ought to remind them to take particular care when quoting technical data. At the level of strategy formulation, if the world can be understood differently then there is no reason to assume that one Army sees things in the same way as another. Interpreting the actions of an adversary does therefore involve trying to get beyond one's own situated point of view by attempting to appreciate phenomena from their perspective.

For the strategist the conclusions that might be drawn from this are twofold. Firstly, when thinking about the way in which armies fight it is important to keep in mind

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[7] L. Wittgenstein, Philosophical Investigations, 3rd, (Oxford: Blackwell, 1992), p. 20, remark 43.
[8] M. Foucault, Power/Knowledge: Selected Interviews and Other Writings, 1972-1977, 1st American, (New York: Pantheon Books, 1980), p. 133.
[9] Grint and Woolgar, The Machine at Work: Technology, Work, and Organization, pp. 32-33.

that there may well be a number of competing views of combat within the military institution itself. This in turn conditions the language that is used to describe the battlefield. Secondly, applying constructivist approaches to the way in which armies think about warfare complicates the work of those strategists who are trying to limit uncertainty and predict military outcomes. This is because more effort is required to expose the values and beliefs of the various relevant actors and at the same time establish how these various views of war gain meaning within a military community. The benefits that might accrue from taking such an approach do, however, outweigh the costs associated with unpacking the reified interpretations that traditionally form the mainstay of strategic analysis. After all, unless effort is put into defining what an army means when it describes war-fighting, how is it possible to understand its actions?

One area where this almost certainly has ramifications is in relation to the literature on military effectiveness.[10] Military effectiveness as a concept can be found in a variety of fields related to establishing the nature of military power.[11] As a result it is problematic to make broad, sweeping generalisations about what the term means. That said, what typically brings the various perspectives together is the desire to relate military capability to political outcomes. And in this respect the idea fits very neatly with the means/ends relationship that is of such concern to the strategist. A constructivist interpretation of military effectiveness would, however, take a considerably more critical stance on the notion. In particular, it would seek to pin down what military effectiveness meant for those actors involved in using the term. This in turn would clarify their values and beliefs and provide the starting place for identifying how the views of one group in the military structure became dominant.

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[10] The work by Millet and Murray on military effectiveness are the most widely quoted authorities on the subject, see for example A. R. Millett, W. Murray and K. H. Watman, 'The Effectiveness of Military Organizations', International Security, Vol: 11, No: 1 (1986) and A. R. Millett and W. Murray (eds.), <u>Military Effectiveness, Volume 1: The First World War</u>, (Boston: Allen & Unwin, 1988).

[11] For a review of the literature on military effectiveness see, R. A. Brooks, Introduction: The Impact of Culture, Society, Institutions and International Forces on Military Effectiveness, in Creating Military Power – the Sources of Military Effectiveness, R. A. Brooks and E. A. Stanley (eds.), (Stanford, CA: Stanford University Press, 2007), pp. 4-9.

In the process the way in which actors sought to understand the world would become clear as would the importance they attached to certain factors over others. No doubt this kind of analysis would undermine the realist account of state power and reveal the socially contingent nature of strategy formulation.

Military effectiveness aside, these ideas have significance in other ways as well. Not only do they open up a research agenda that relates to other types of military hardware but they also unlock older forms of intellectual discourse to new types of analysis. For example, the debate concerning the RMA has, since the end of the Cold War, come to dominate the study of technology, especially in the United States.[12] Putting aside the technologically determinist overtones that such an analysis tends to reproduce, the RMA theorists crucially leave out the beliefs and values of those that are involved in the process of building and selecting equipment. Instead technology is reified in such a way as to encourage the researcher to assume that a technical artefact has certain essential meanings irrespective of its context. Consequently, with the meaning of an artefact fixed the inherent danger in this way of looking at technology lies in its intrinsic ethnocentrism. Whether an artefact in one Army has the same connotations as a similar device in another is something that simply cannot be determined by quantitatively examining the inventories of the organisations involved. It may well be appropriate, therefore, to re-examine the significance of various technologies for a wide variety of military organisations in an effort to develop a deeper understanding of the socio-technical factors involved in weapon selection.

In a similar vein it has been noted that military institutions are increasingly '...standing, standardized and technologically structured armies requiring a capital-intensive form of militarization'.[13] Whilst this accurately portrays the trend in military structure, such observations do not explain how armed forces see the

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[12] C. S. Gray, Recognizing and Understanding Revolutionary Change in Warfare: The Sovereignty of Context, (Carlisle, PA: Strategic Studies Institute, 2006), p. v.

[13] T. Farrell, 'World Culture and the Irish Army, 1922-1942', in The Sources of Military Change: Culture, Politics, Technology, T. Farrell and T. Terriff (eds.), (London: Lynne Rienner Publishers, 2002), p. 69.

battlefield. This is an important distinction because, as several academics have noted, despite broadly similar configurations, different armies fight in manifestly different ways.[14] To look at the form of a military structure without looking at the way it makes sense of the world leaves out crucial elements in the description of that organisation. In particular, it ignores any analysis or exploration of how armed forces think about themselves and what they believe will be required of them in battle. In this respect, an SST type analysis of an Army's socio-technical systems can help to uncover not just its values and beliefs but more specifically the way it constructs representations of the battlefield. This could give some insight into how all the relevant actors within a military organisation not only understand war but also intend to go about fighting. This in turn ought to help expose the underlying debate that cannot easily be seen within the doctrinal and training publications that armed forces regularly produce.

Applying SCOT to the equipment and organisation of other armed forces could, therefore, further substantiate the extent to which this methodology is appropriate in a military context. At the same time, a systematic analysis of the socio-technical arrangements that exist in the armed forces of a variety of countries might also produce unexpected results that have deeper implications for the study of strategy. If nothing else, however, SCOT can help prevent technological determinism from creeping into accounts of technical change and at the same time, refocus attention on the way socially contingent choices shape the design, development, production and procurement of weaponry.

[14] See for example, Samuels, Command or Control?: Command, Training and Tactics in the British and German Armies, 1888-1918; French, Raising Churchill's Army: the British Army and the War Against Germany, 1919-1945.

Appendix One - Rifle Photographs[1]

Weapons discussed in Chapters One and Two

Martini-Henry, Mk.I, .450"

[1] All photographs courtesy of the Royal Armouries, Leeds.

Enfield-Martini, .402"

Owen Jones, .402"

Close up of the Owen Jones breech action. The action is the same as the Martini-Henry but has an added side magazine.

Lee-Burton, .402"

Close up of Lee-Burton, utilising the Lee bolt-action and Burton sliding side magazine.

Lee-Metford, Mk.I, .303"

Close up of Lee-Metford breech action. Notice the cut-off mounted in the receiver immediately above the magazine.

Short Magazine Lee-Enfield, Mk.I (C), .303"

Weapons discussed in Chapters Four, Five and Six

Experimental Model No.2 or Rifle No.9 Mk.I, .280"

No.4 Rifle, Mk.I (L), .303"

Bren, Mk.I (L), (Light Machine Gun), .303"

Sten Mk.II, 9mm

Vickers, Mk.I (L), (Heavy Machine Gun), .303"

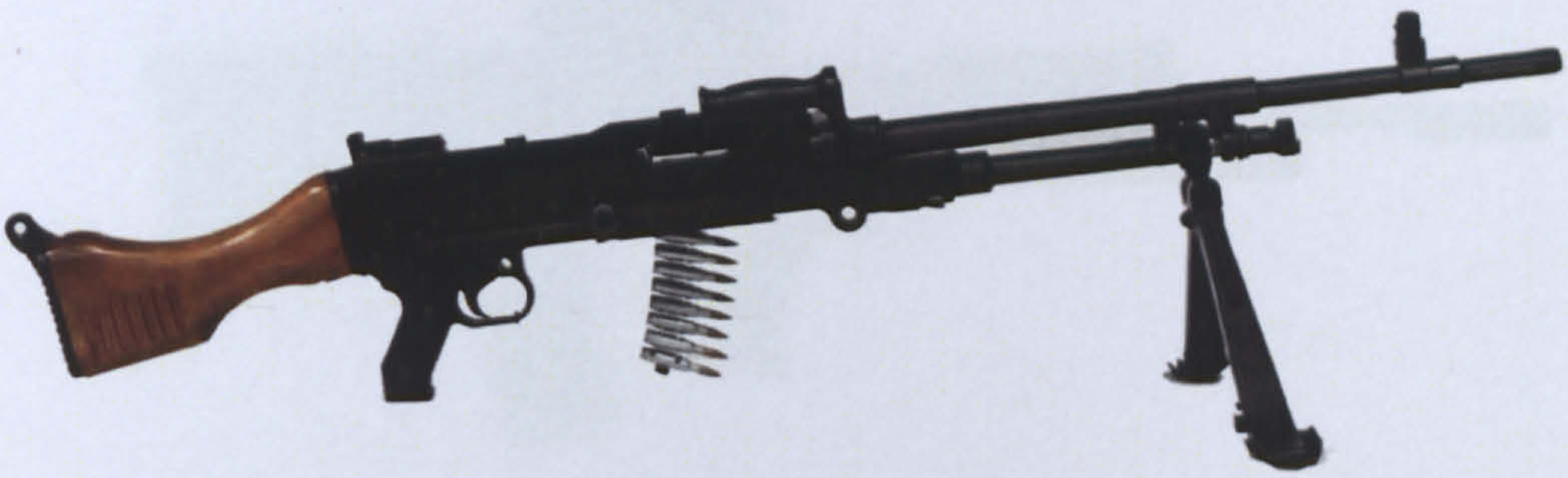
***Fabrique Nationale d'Armes de Guerre, Fusil Automatique Léger (this version with a folding butt),* 7.62mm**

M1 Garand, .30'06

M14, 7.62mm

Weapons discussed in Chapter Seven

LMG, L7 A1/A2 (General Purpose Machine Gun), 7.62mm



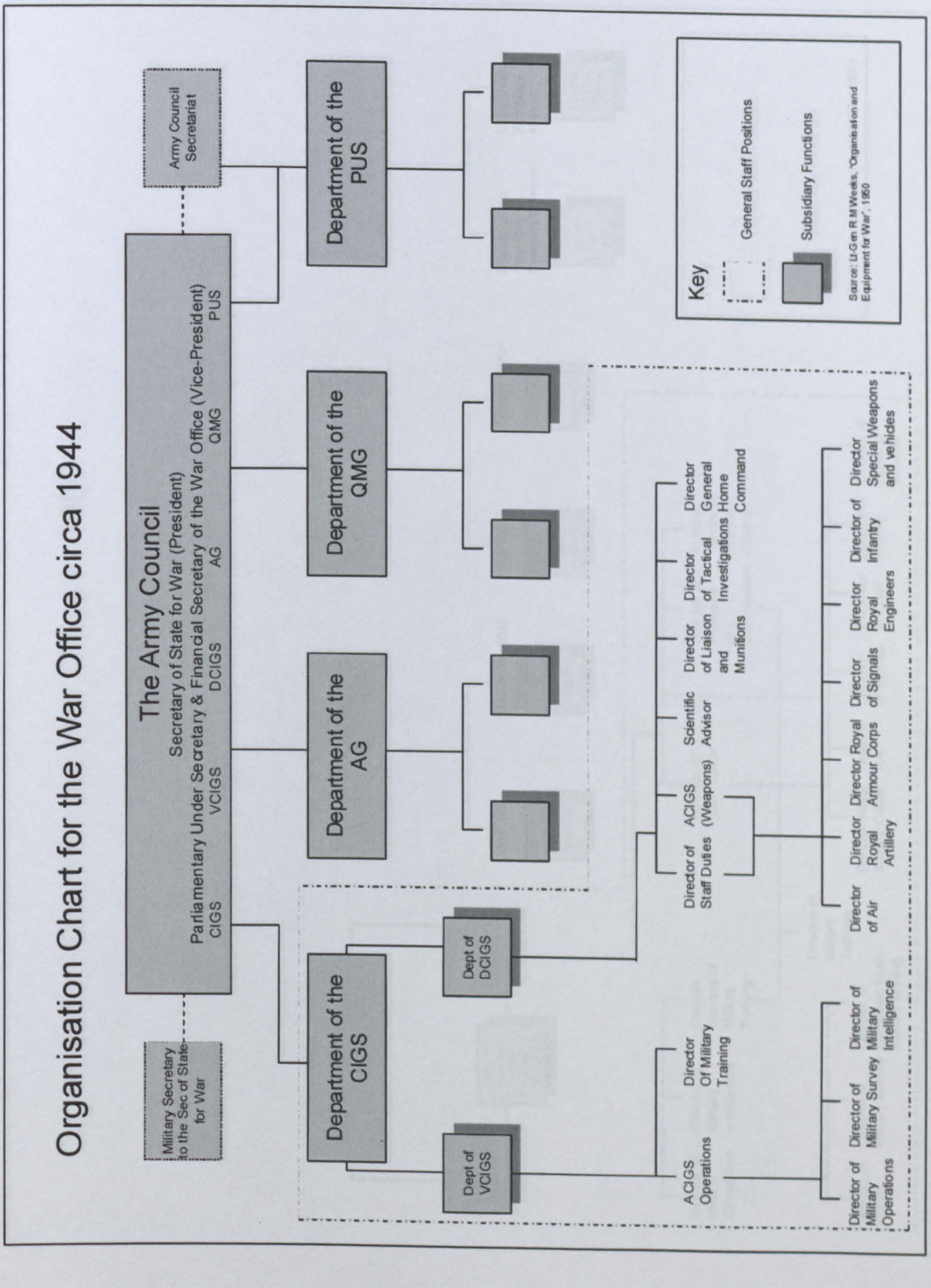
M16, 5.56mm

Enfield Weapon System, 4.85mm (prototype weapon for firing 4.85mm ammunition)

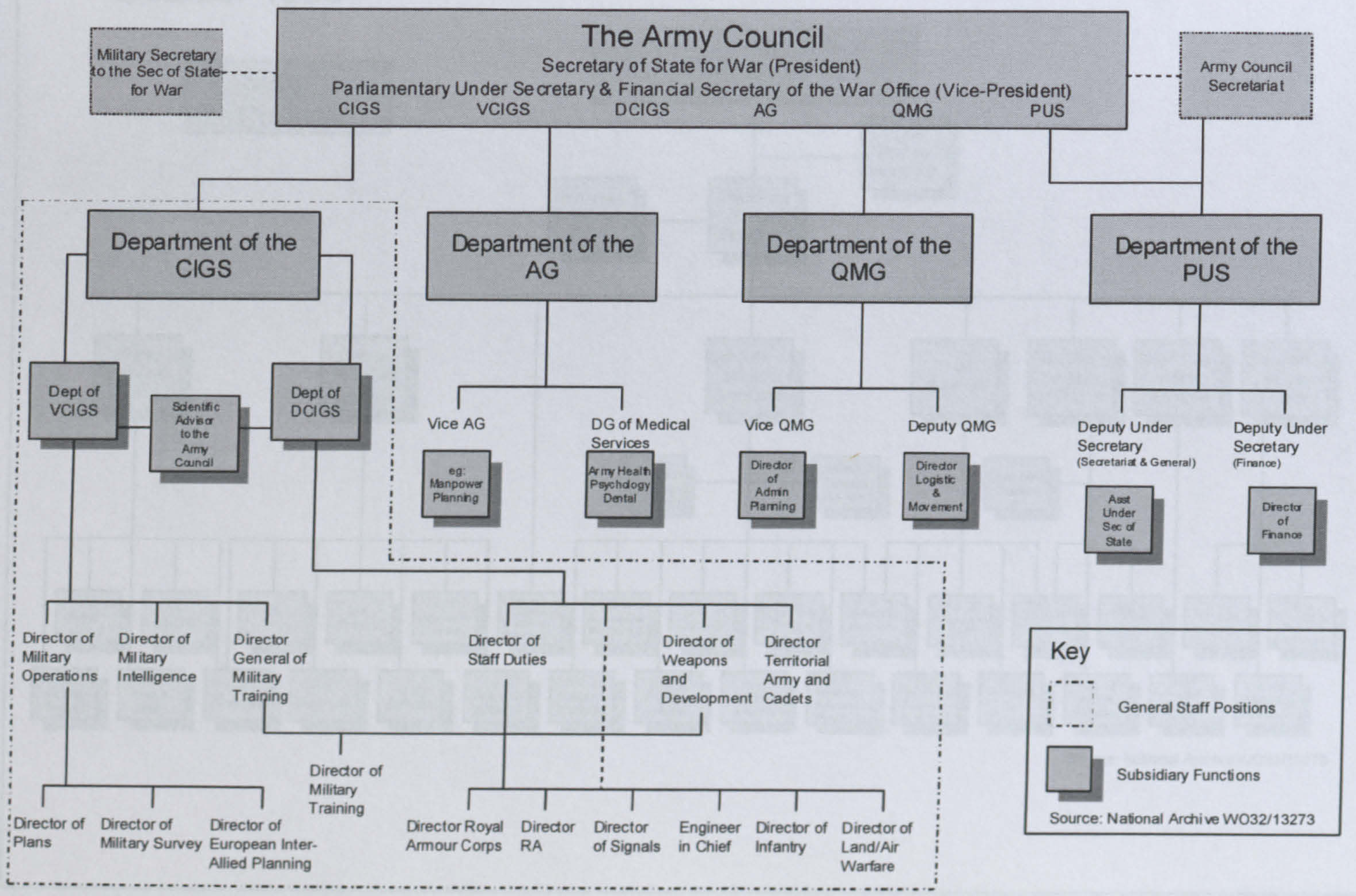
SA80, Rifle L85 A1, 5.56mm

SA80, LMG L86 A1 (Light Support Weapon), 5.56mm

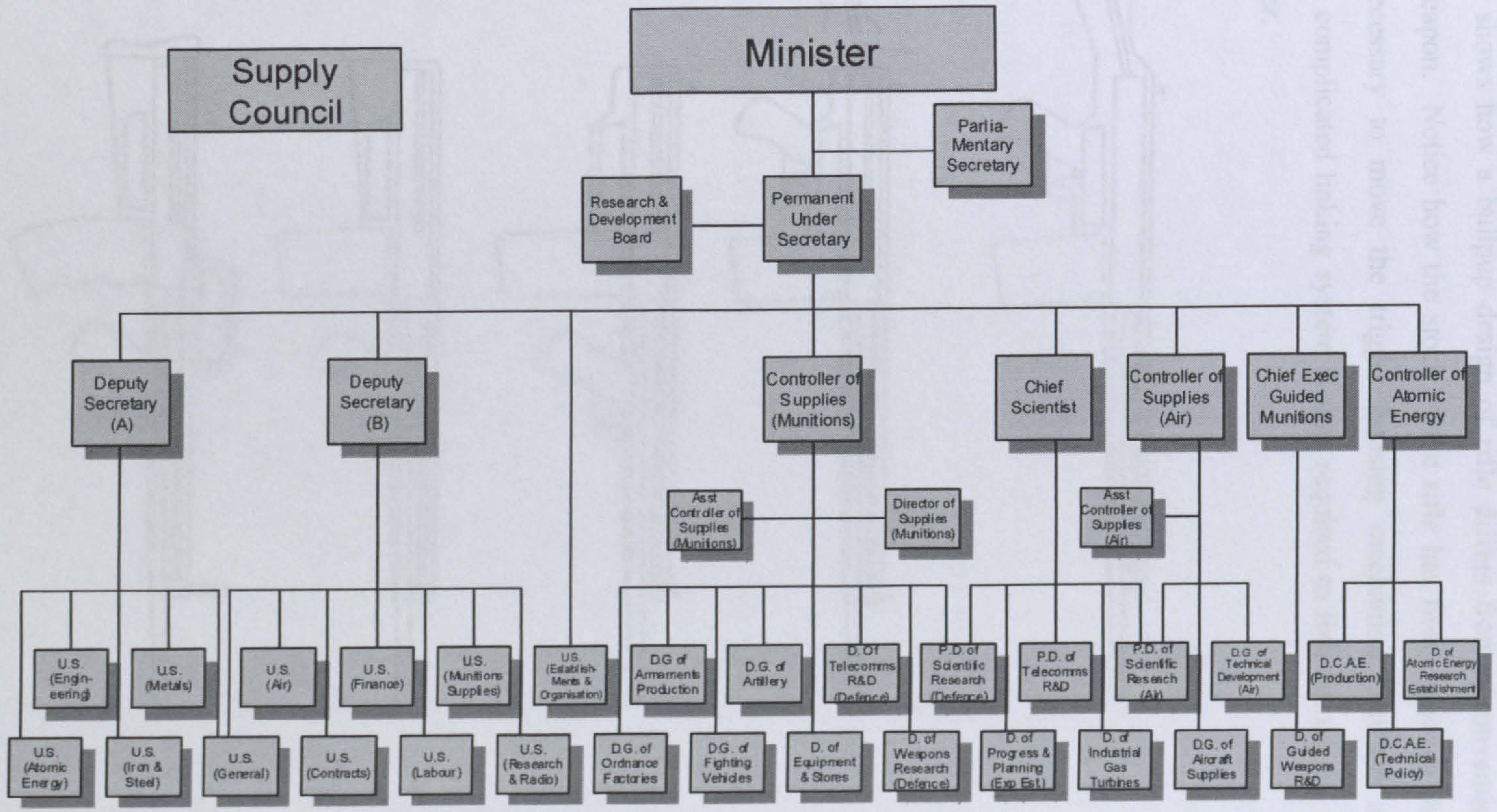
Appendix Two - Organisation Charts



Organisation Chart for the War Office in 1950



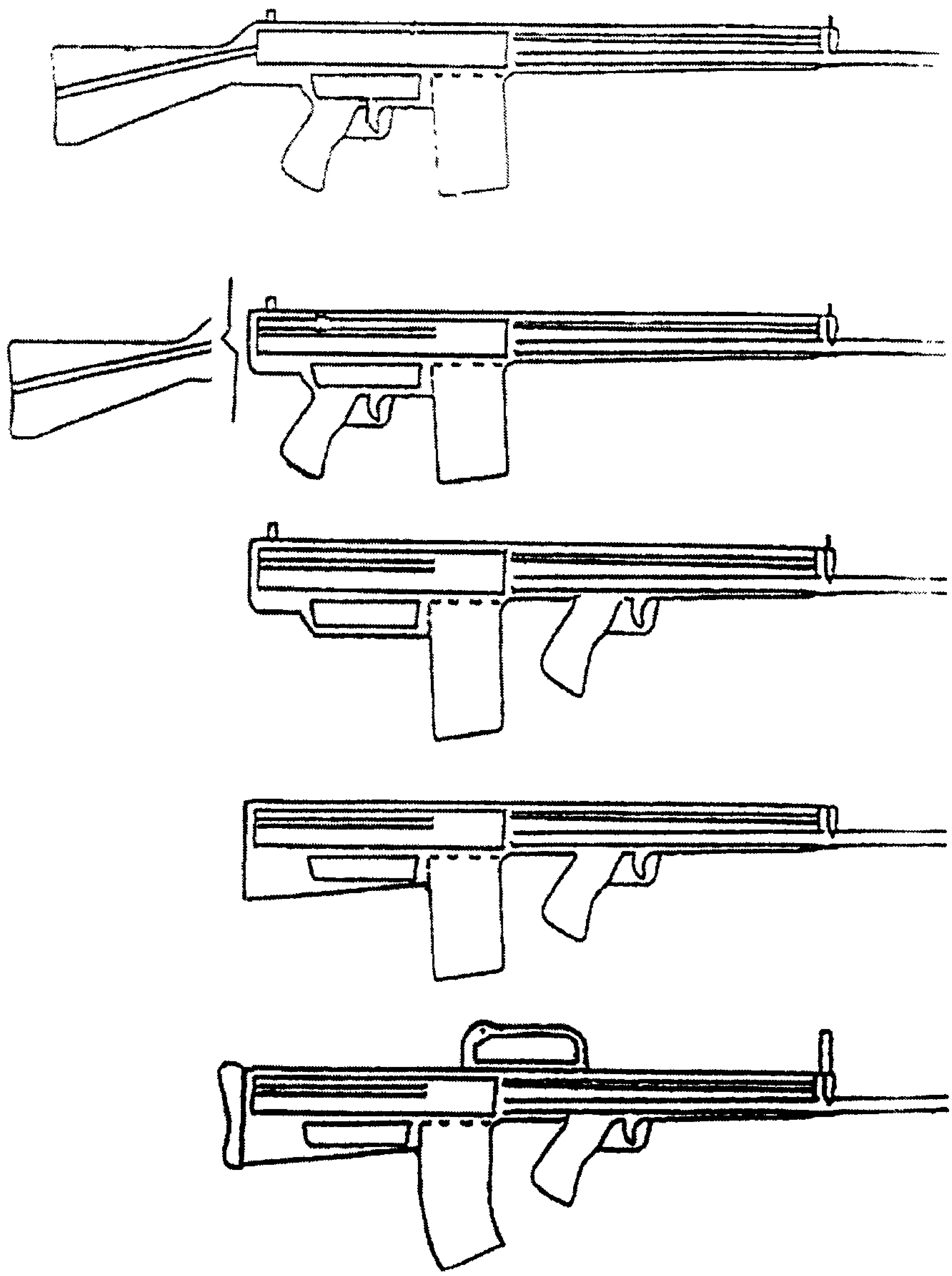
Ministry of Supply – Headquarters - Top Level Organisation at October 1950



Source: National Archive WO32/13273

Appendix Three - Rifle Configurations: Conventional versus Bullpup Designs

This diagram shows how a bullpup design of rifle differs from a conventionally configured weapon. Notice how the stock of the rifle has been removed thereby making it necessary to move the trigger housing mechanism forward of the magazine. A complicated linking system is then required to link the trigger to the bolt and striker.



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DEFE 7, DEFE 15, DEFE 24, DEFE 48, DEFE 70, DEFE 72

Foreign Office

FO 371

Home Office

HO 195, HO 325

Prime Minister's Office

PREM 3, PREM 11

Ministry of Supply

SUP 5, SUPP 6

War Office

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